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MACHINE DESIGN

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PARTS MATERIALS METHODS FINISHES

OF MACHINES OF EVERY SIZE AND TYPE

"THE PROBLEM HAD US STUMPED UNTIL WE TRIED TEXROPE!"

Allis-Chalmers Texrope Drives Again Solve a Difficult Design Problem . . . Help Dings Magnetic Separator Company Get Better Performance for Their Machines . . . Increase Sales Appeal!

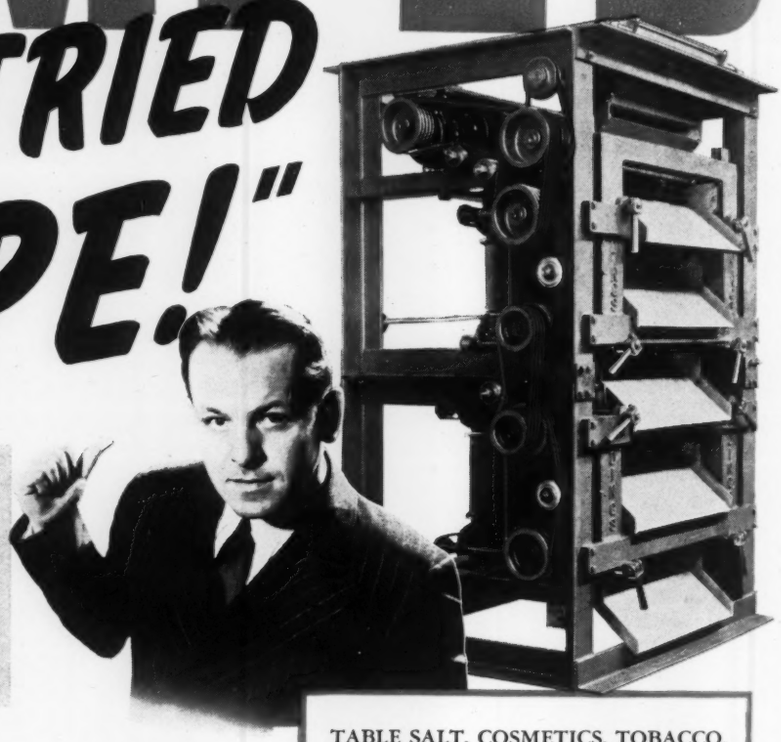

TABLE SALT, COSMETICS, TOBACCO, seed, silica sand, zinc, tungsten, brass, aluminum—these are only a few of the hundreds of processed materials from which tramp iron is magnetically removed by the ingenious machines of the Dings Magnetic Separator Company. Dings' engineers give Texrope Drives much credit for the unusually efficient operation of their machines.

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It was to solve this problem that Allis-Chalmers transmission engineers cooperated with design engineers from the Dings company.

Designs were drawn up . . . Texrope V-belt Drives were installed . . . tests were made . . . units were sold and put into use. Now, after years of field performance, the Dings company makes this enthusiastic report —

"We primarily used roller chain drives, but Texropes not only did away with the disadvantages of having the drive attracted by the magnet, but they gave us a drive that is absolutely quiet, is abrasive resisting, and the slow speed was found no disadvantage at all. As a matter of fact, some of these drives have been in daily operation for four or five years and are still going good."

Texrope Drives — For Long-Life, Low-Cost Transmission!

That's good news to any machine designer with a transmission problem. For, although you may have no magnets in your machines to bother you, it proves again that Texrope V-belt Drives are an answer to an amazing number of all transmission needs!

It will pay you, as it has paid hundreds of other equipment manufacturers, to use these modern drives in the machines you build — for increased sales appeal, as well as for the advantages of Allis-Chalmers cooperative engineering.

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MACHINE DESIGN

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MACHINE DESIGN

Mechanical Improvements Parallel Size-Weight Reduction

By C. H. Merritt
Dictaphone Corporation

WHILE light weight, compactness and portability received primary emphasis in the design of the Cameo dictaphone in *Fig.* 1, improvements in mechanical features are corollaries of the reduced size and weight. This machine is built around a frame of permanent mold cast aluminum supported by a diecast aluminum base. Driving motor, electrical parts, and some controls are attached to the bottom of the frame and housed by the base, as *Fig.* 2 shows. Remainder of the mechanism is supported on the frame above and enclosed in a suitable cover, as may be clearly seen.

Because the size of the motor controlled the depth of the base, a new

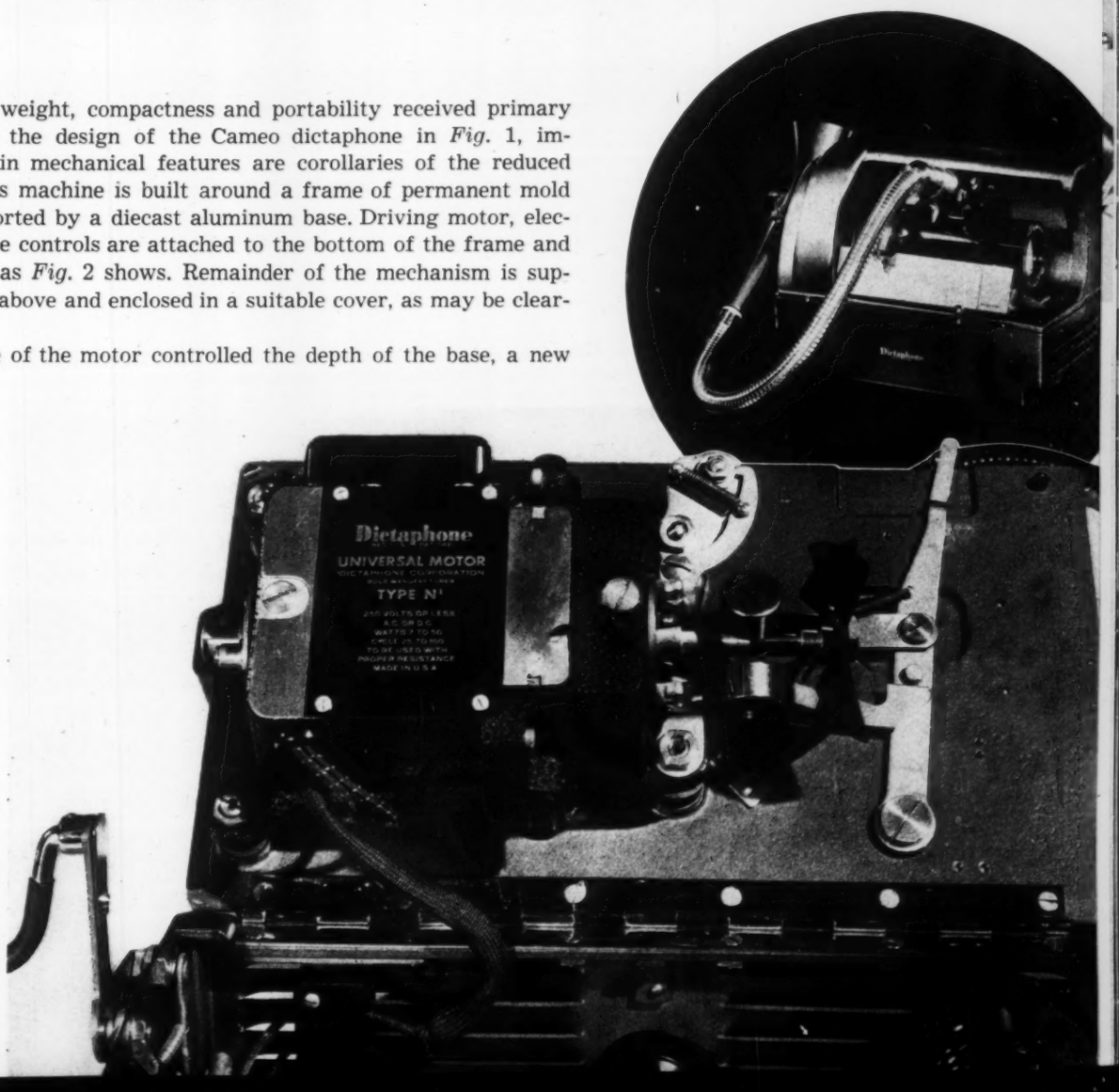


Fig. 1 — Top — Improvements in mechanical features were possible because of reduced size and weight in the Cameo dictaphone.

Fig. 2—Cast aluminum frame holds driving motor, electrical parts, as well as some controls

motor was designed with a flattened field and a new frame, affording a large saving in space. New and old motors are compared in *Fig.* 4. Operating characteristics of the older motor were satisfactory. A universal motor of about 750 revolutions per minute, operating on an input of 230 milliamperes and a voltage as low as 32 volts direct current, it delivered the required power and operated with exceptional freedom from noise and vibration. Addition of a suitable resistance permitted operation on all currents normally encountered. These characteristics are retained in the new design.

Change in shape of motor was desirable from the manufacturing angle in addition to the space saving possible. Alignment of the frame, divided in two parts, was formerly maintained by a telescoping fit with a narrow shoulder. Although the bearings were line reamed in place, some manufacturing difficulties were experienced in securing proper alignment.

The new motor frame, U-shaped instead of cylindrical, has a broad flange for positive alignment of the halves and strength is secured by internal bosses and by a boss which profiles the opening in the frame. The field coil, bolted into the frame in the same way as in the earlier unit, serves to increase the rigidity of the frame but is not relied on to maintain bearing alignment. This is so because the two parts of the frame containing the bearings form a complete unit with or without the field coil. The opening in the frame, closed to a large extent by the field laminations, is covered by aluminum plates providing easy access to the commutator for cleaning.

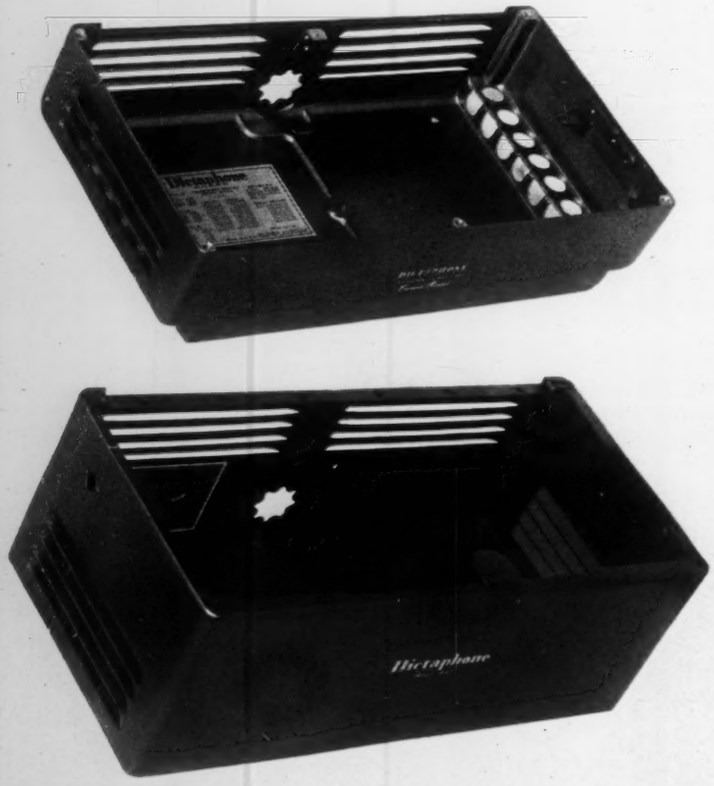
Control Levers Recessed into Frame

To conserve space further the control levers and interlocking parts on the bottom side of the frame are recessed into it. In this manner, it was possible to reduce the height of the base from 4½ inches to 3 inches. After these savings were effected the dimensions of the machine were reduced from 12½ inches by 6¼ inches by 9¾ inches high to 11½ inches by 6¼ inches by 7⅞ inches high with a contact base of 10 inches by 6¼ inches, a saving of 39 per cent of the volume of the earlier model.

An adjustment was provided in the former motor whereby the brushes could be placed in the plane of best commutation. This was found unnecessary except for high frequency currents over 100 cycles. By eliminating this adjustment, the design is simplified and the possibility of wrong adjustment eliminated. Brush holders in the new motor are molded plastic with brass inserts carrying the current to the brushes. They are designed with an easily removed screw cap and accommodate an exceptionally long brush spring of 38 turns to maintain the difference in spring pressure between worn and new brushes at as low a figure as possible. Other changes in the motor design include an increased shaft diameter from 5/16 to ⅜-inch, and a larger brass oil slinger to throw any oil seepage from the bearings clear of the commutator. The motor is suspended at four points by field springs to absorb any vibration which may be present.

The best grade of gray iron had always been used for the main frame and motor frame, but to take advantage of the weight savings possible permanent mold aluminum castings are used for these parts. In the completed machine, this amounts to a reduction of over one-third (from over 30 pounds for the older model to less than 20 pounds for the new).

For the first time, diecastings were chosen for the base and for the cover, competing favorably with sheet metal fabrication because of the thin but strong sections now available in diecastings and because of the free rein which could be given the stylist in molding the exterior of the machine to express its purpose and



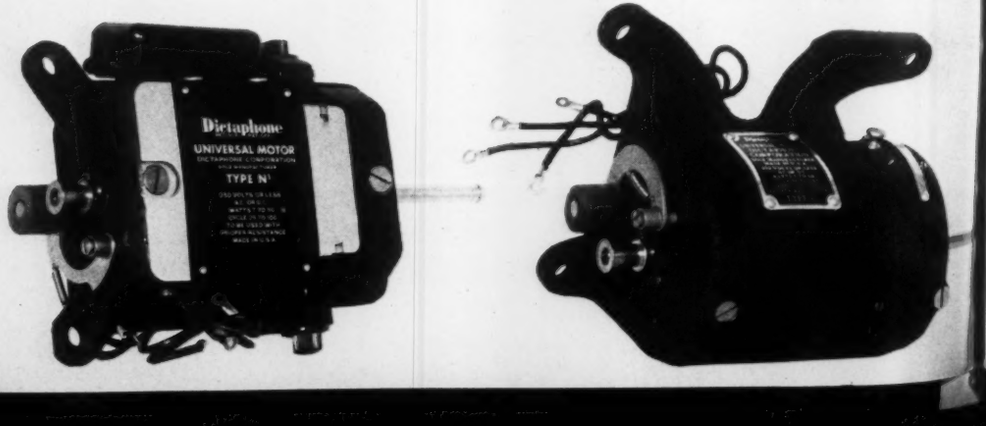


Fig. 3—Above—New base of diecast aluminum is at top, former base below. Fig. 4—Right—Gain in compactness is clearly shown in this comparison of new, old motors

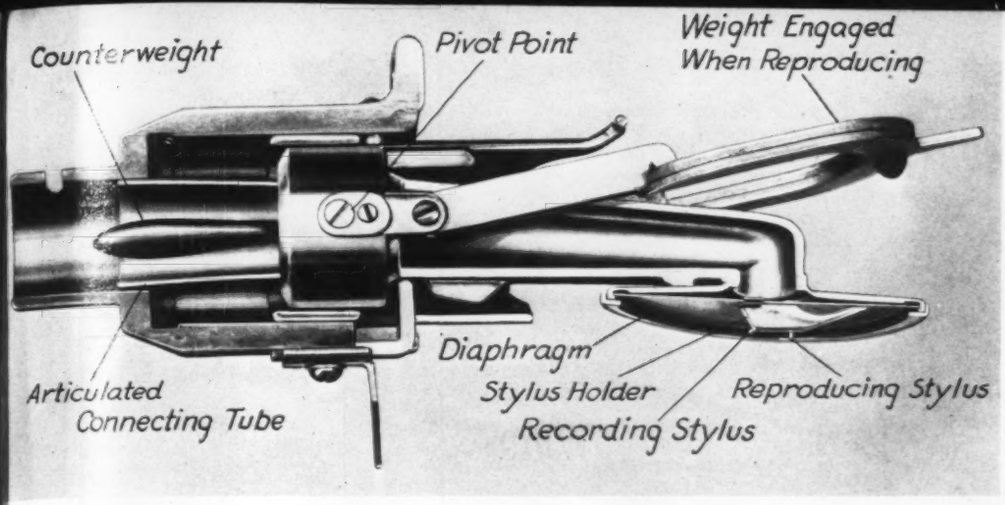


Fig. 5—Left—Recorder is supported by counterweight but not rigidly connected to it. Outside vibration is damped immediately

Fig. 6 — Below — Mechanism for automatically starting machine utilizes mercury switch, permitting size reduction and simplifying operating linkage

its qualities. There is also an increased use of plastics in the new machine both because of their advantages as a dielectric, and because of the possibilities offered in meeting the designer's specifications for contour and color. The cover is designed with large radius curves blended naturally together and harmonizing with the rotating wax cylinder.

In previous models, the design of the base was not particularly complicated, and although larger presses were required than were available in the plant, there did not appear to be a logical basis for considering anything but sheet metal welded construction. The stylist conceived the idea, however, of undercutting the base and thereby achieving several advantages though at the expense of considerably complicating the base itself. Old and new bases are contrasted in *Fig.* 3.

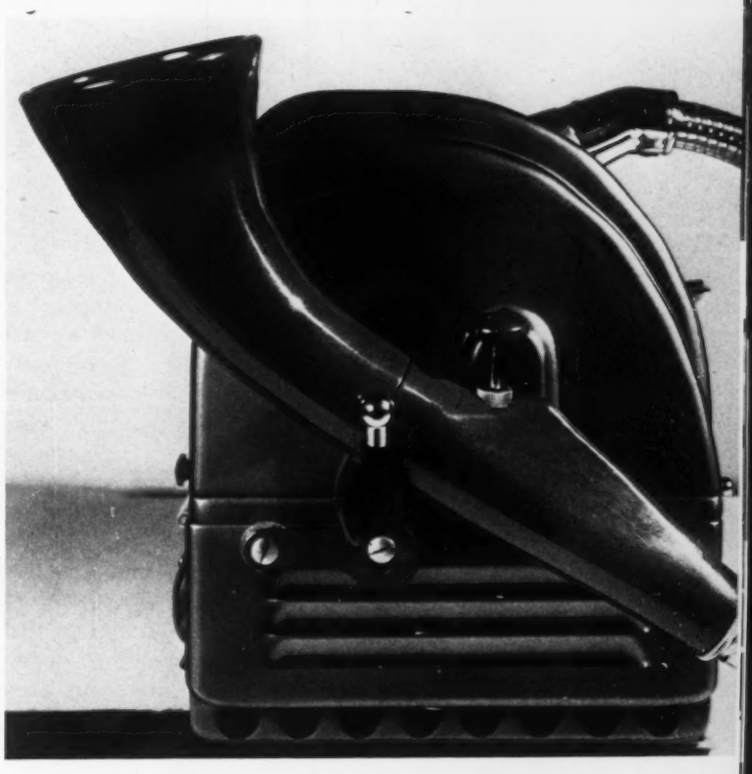
In addition to the impression of lightness and the improved appearance which the undercuts give the machine, there is a very practical advantage in that they provide convenient hand-holds for moving the machine about. Also, ventilation in the base is improved through piercings at this point which are almost invisible when the machine is in normal use.

Additional ventilation is secured through louvres in the ends and the rear of the base. These louvres are lanced cold in the 1/16-inch wall casting in one operation on a blanking press. This rather startling operation is made possible by a careful choice of the alloy used in casting the base, and by shaping the die to avoid as much as possible the rather severe drawing action at the ends of the louvres.

Good Diecasting Practice Followed

Reinforcing bosses and other features of the design follow good die casting practice although, of course, they are quite different from the pressed steel base. Steel reinforcing pieces are screwed into the top edge of the base in suitable bosses to provide a rigid support for the piano hinge by which the frame is attached, and to provide locating dowels and a method of closure. Even with the addition of these steel parts, the new base weighs only two pounds nine and one-half ounces as compared with the weight of four pounds and three ounces for the old base.

Although much attention is given to the design and construction of the auxiliary features history of dictating machine development is marked by steady improvement in recording. The recorder, *Fig.* 5, can be



thought of as a threading tool cutting 160 threads per inch at a varying depth averaging about .00035-inch. Depth of thread cut in the record is made to conform to the vibrations of the voice by means of the diaphragm to which the cutting tool is attached. If this tool, a sharp sapphire, is not rigidly supported, there will be chatter marks which produce background noise in the record. It must also be free to respond to the full range of frequencies of the voice without taking charge itself and vibrating on its own accord.

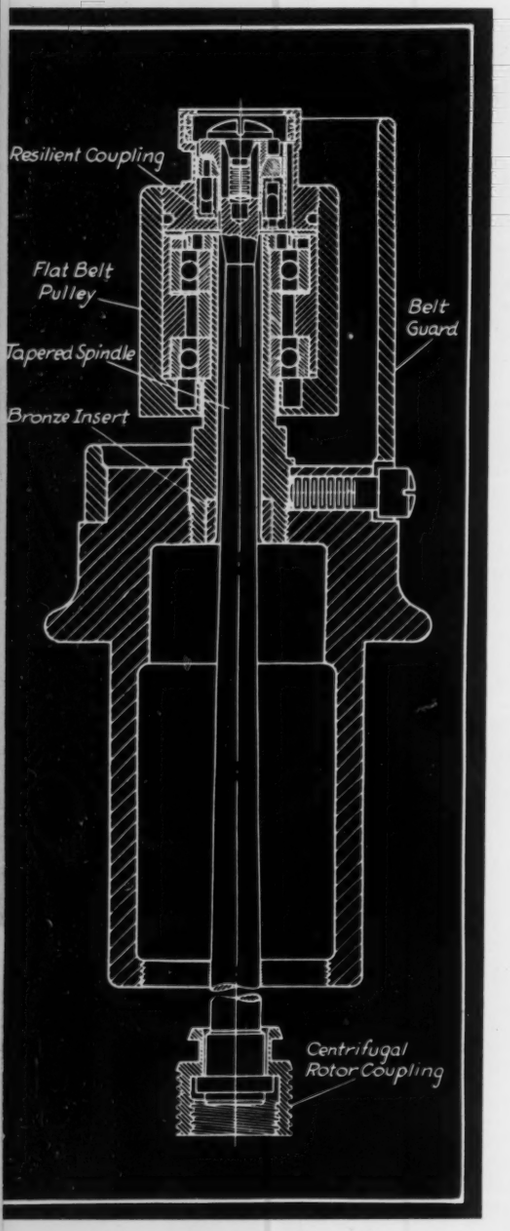
Extremely shallow as is the thread cut on the cylinder surface, it is desirable to make it still shallower than is possible without making the parts of the recorder so delicate that they would be easily subject to damage and difficult to brace with sufficient rigidity. Difficulty with the counterbalance has always been instability of the recorder or a tendency to vibrate to its natural frequency, sometimes entirely leaving the recording surface.

The recorder is supported by a counterweight but not rigidly connected to it as the illustration shows. Any

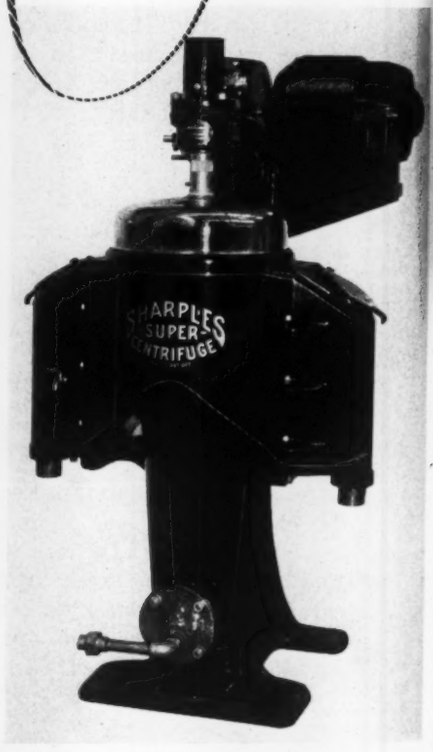
(*Concluded on Page* 92)

Scanning the Field

FOR IDEAS



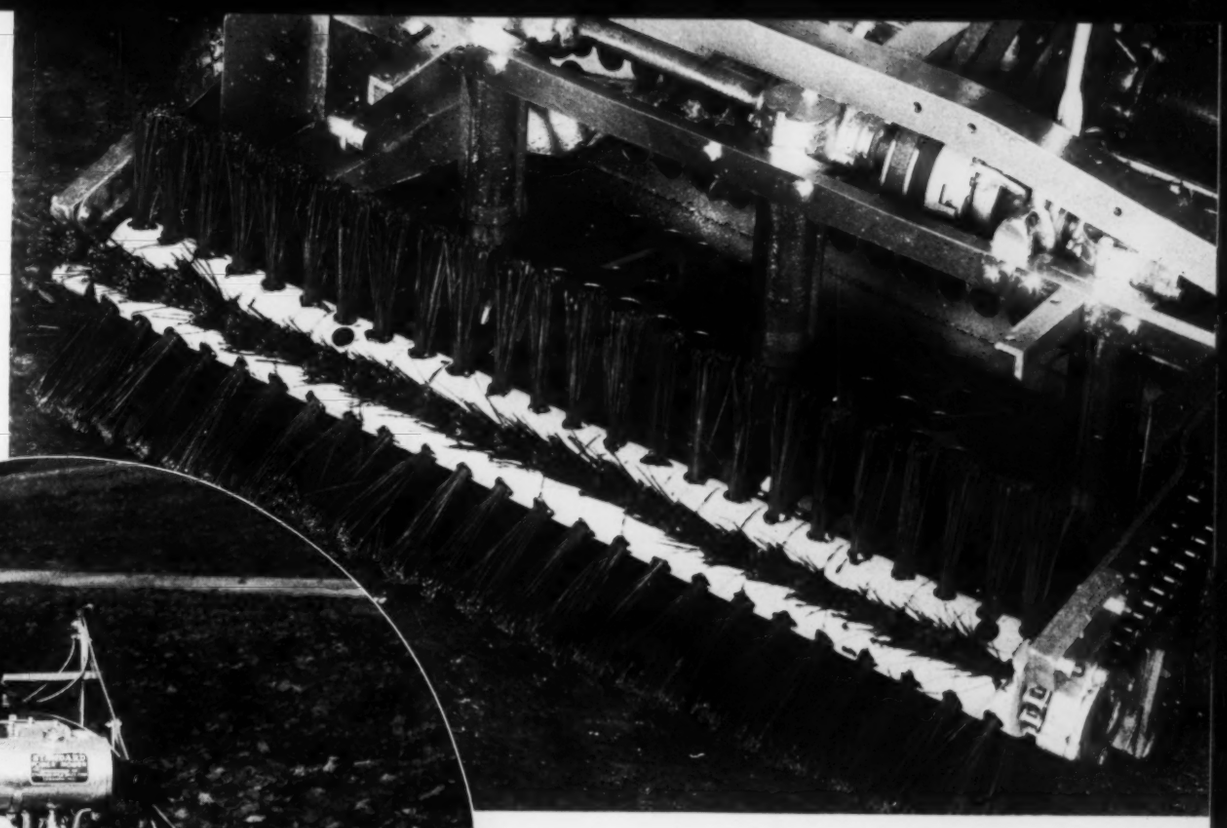
Coupling cushions shocks from unbalance forces in this Sharples centrifuge with normal operating speeds well above critical speed. When the critical point is passed the rotor shifts in position so as to make its center of rotation its center of mass. Any slight out of balance will, therefore, result in rotation that is not on the geometrical center and this means that for each revolution the spindle must flex. To permit such flexing, it is reduced in diameter near the top. A resilient coupling is introduced to cushion these rapid shocks, preventing wear of metallic surfaces.

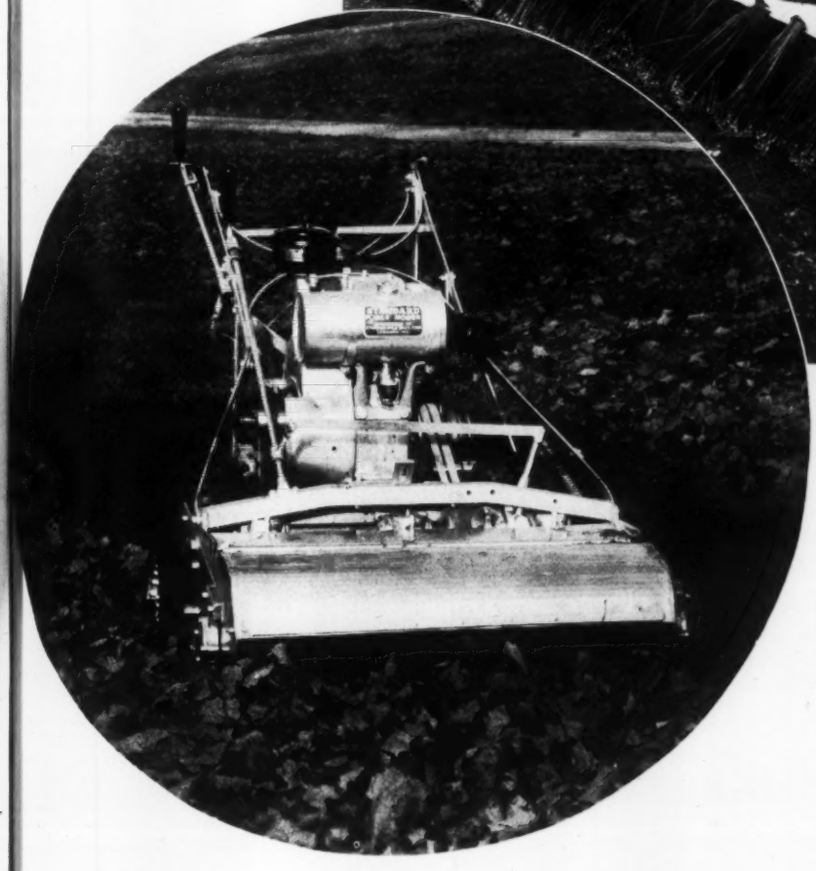


Operating at speeds between 15,000 and 19,000 revolutions per minute the rotor is driven from above, being coupled to the lower end of the spindle shown in the blueprint. This spindle passes through a hollow stationary sleeve to the upper end of the bearing assembly which is of conventional design with outer races rotating. A screw with a taper under its head expands the split upper end of the spindle to grip tightly inside a piece that has teeth extending horizontally. These teeth mesh in slotted recesses in a female clutch with two pins extending downward entering holes in the resilient coupling of neoprene. The coupling has two other holes extending upward, located 90 degrees from the clutch pin holes to engage pins in the pulley cap.

Lubrication is effected by dropping oil on top of spindle screw. Centrifugal force throws the oil against a felt ring through which it passes into holes that communicate with the bearing interior. When rotor stops, oil drains into recess at bottom of pulley to rise again to operating position when centrifugal force is applied. A rubber ring under cap expands under centrifugal force and seals the joint against oil leakage.

Clutch is provided so that spindle may be pushed upward to facilitate disassembly. Taper permits binding in upward position against a bronze insert at the lower end of the hollow sleeve



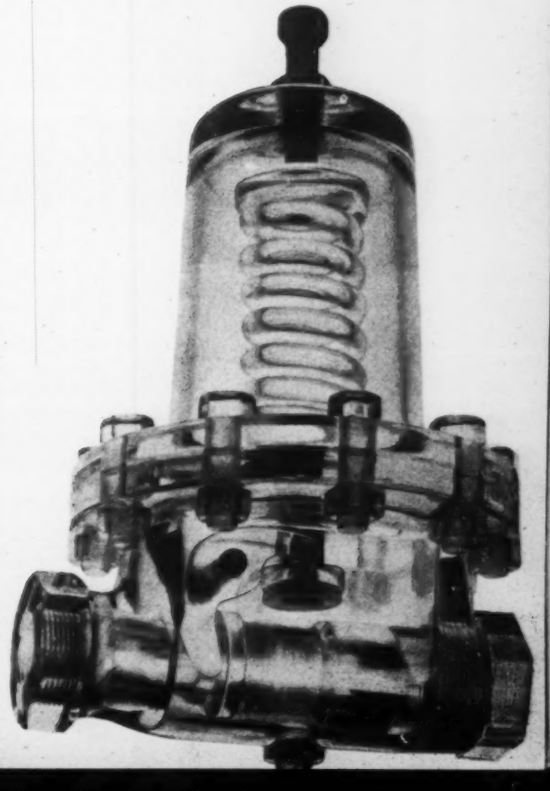


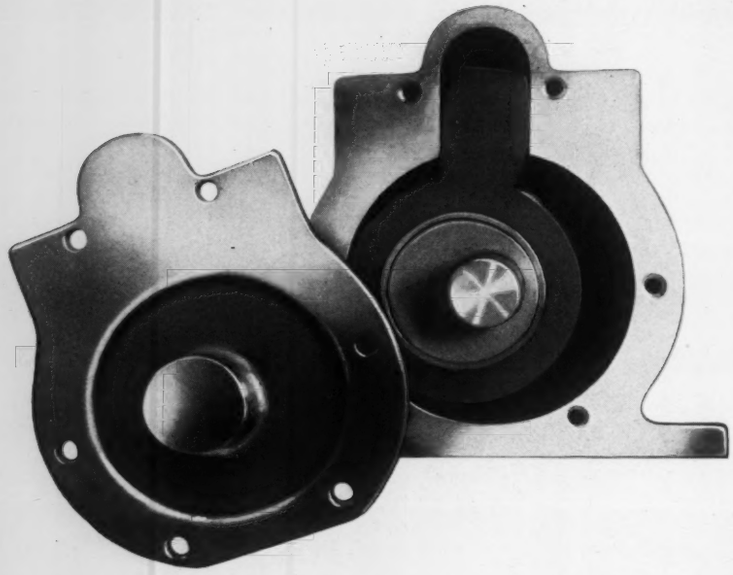
Transparant plastic models have proved their usefulness repeatedly in demonstrating the working principles of mechanical parts. Sales value of such promotional methods is unquestionable. The model shown is an example of the rather complex type of unit it is possible to fabricate of Lucite and Plexiglas. It is an exact model of a pressure reducing valve constructed entirely of transparent plastic, even to the spring which is sufficiently flexible to be compressed to illustrate its action. Various combinations of color for working parts may be used.

Manufacturers who have used transparent models are, according to the Transparent Plastics Products Co., enthusiastic about the results

Beater blades and rotating brush assembly replace the standard grass cutting disks on a new power mower to disintegrate fallen leaves and replace them on the turf as fertilizer. Leaves are brushed on to a perforated grill where special beater blades break them into tiny bits facilitating rapid disintegration. Manufactured by the Standard Manufacturing & Sales Corp., blades create sufficient draft to force the small particles through the holes in the grill so that they become nested between the blades of grass.

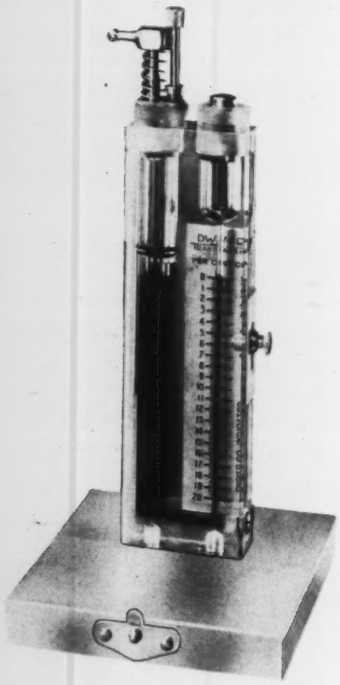
Power takeoff is through V-belts to beater drive. Gearing for beater shafts is enclosed in cast housings as well as the shafts, while brush is driven from a roller chain and sprocket. In operation a hood encloses the entire pulverizing unit, presenting a neat appearance and assuring that all leaves are redeposited in small particles





Foreign particles such as sand or grit do not harm this unusually simple but effective pump. Consisting of eccentric rotor turning inside an impeller which is held in position by a tongue, liquid is forced out one side by wiping action of eccentric and sucked in at the other.

Impeller is neoprene and, being resilient, permits the passage of sand, grit or other foreign matter without impairing the efficiency of the pump. Because of this feature it is especially useful in marine service for pumping bilge water. Also, the resistance of the impeller to chemical action makes the pump, developed by Eco Engineering Co. useful for chemicals, petroleum products



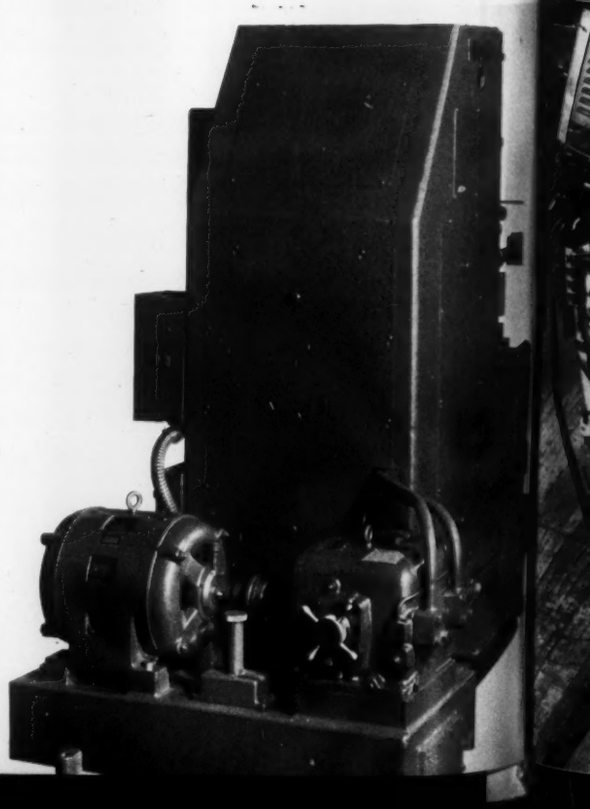
Simplicity, accuracy as well as compactness and reduced weight are achieved in the pocket CO_2 indicator machined from solid Lucite. Drilling and reaming the indicating tube and chambers direct into the plastic material eliminates strains that otherwise would occur when separate parts are used.

Breakage is virtually impossible and the plastic is not affected by the absorbent fluid in the indicator. Designed by F. W. Dwyer Manufacturing Co., plunger valves and all metal parts that come in contact with the chemical solution are stainless steel. If accidentally overturned, the valves close and make impossible any leakage of fluid

External drive unit has recognized advantages in the broaching machine illustrated. While the original machines of this type manufactured by the Oilgear Co. were arranged with the hydraulic pump and motor fully enclosed within the frame, it was found possible to simplify the frame structure as well as the installation of the shuttle mechanism and piping by arranging the pump and electric motor for direct drive and mounting them on a reservoir integral with the base on the back of the machine.

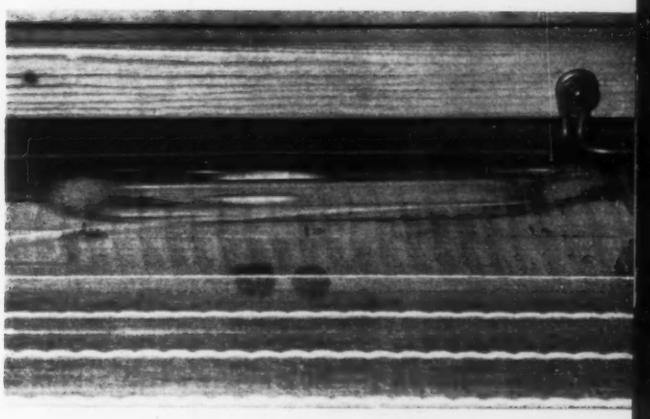
This permits additional space for a larger coolant reservoir and enables separation of the reservoir of the hydraulic pump from the cutting lubricant reservoir. Mounting the pump and electric motor on the outside has in no way complicated the piping in the hydraulic system. It has made the pump and the electric motor more accessible for any adjustments which may be necessary.

Solenoid operated pilot control permits independent adjustment of the broaching and return speeds and eliminates the need of external volume control valves, directional oil flow control valves or relief valves. Flow of oil is reversed by action of the pump



Photography "Stops" High Speed Motions of Machines

By Victor Sepavich and Albert Palmer
Crompton & Knowles Loom Works



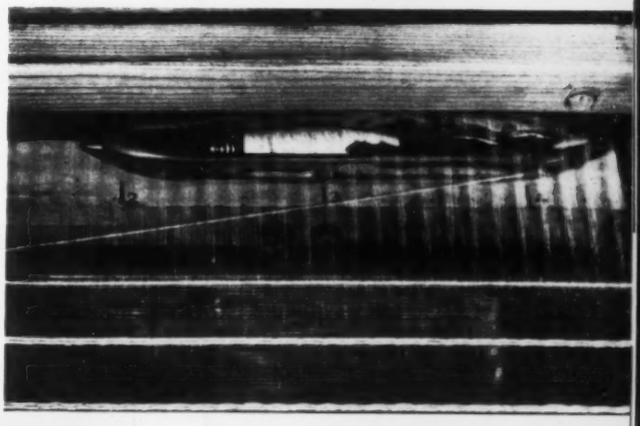


Fig. 1—Shutter speed of the still camera used in this photograph was not great enough to "stop" the shuttle completely. Fig. 2—Below—With aid of the stroboscope, exposure time of the same view was extremely short and the shuttle was caught clearly

IN THE analysis of rapid machine motions when it is not feasible to have connection or contact between the body to be studied and the measuring apparatus, the most satisfactory and economical method combines the power stroboscope with almost any type of still camera.

Other types of photographic equipment are undesirable for various reasons. Although ultra-slow motion cameras are very useful in such analysis, they are expensive and involve costly apparatus or services. Hence they are unsuitable except for special studies. Single exposure cameras employed alone are useful only for instantaneous single views of the mechanism being studied, unless some means is devised for taking multiple exposures on one plate through some form of shutter control

From a paper presented at the Spring meeting, ASME.

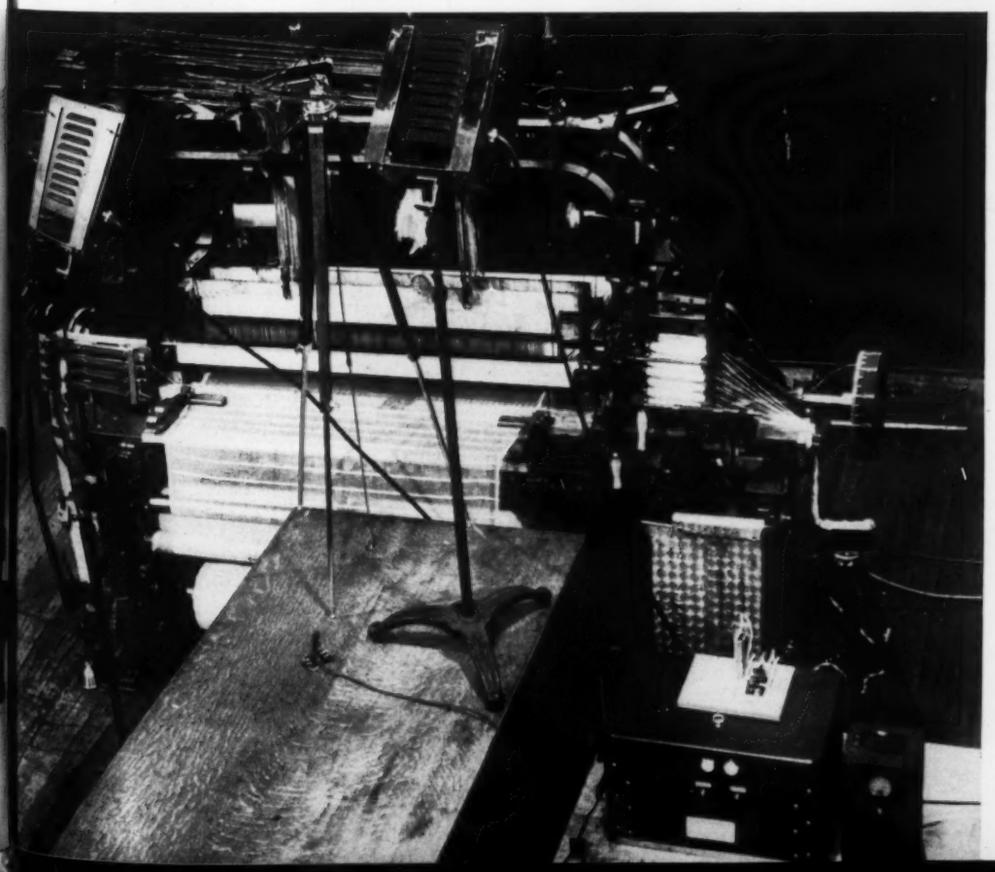


Fig. 3 — Left — Typical test arrangement for the study of shuttle flight. The shuttle must complete 162 total passages across the loom per minute

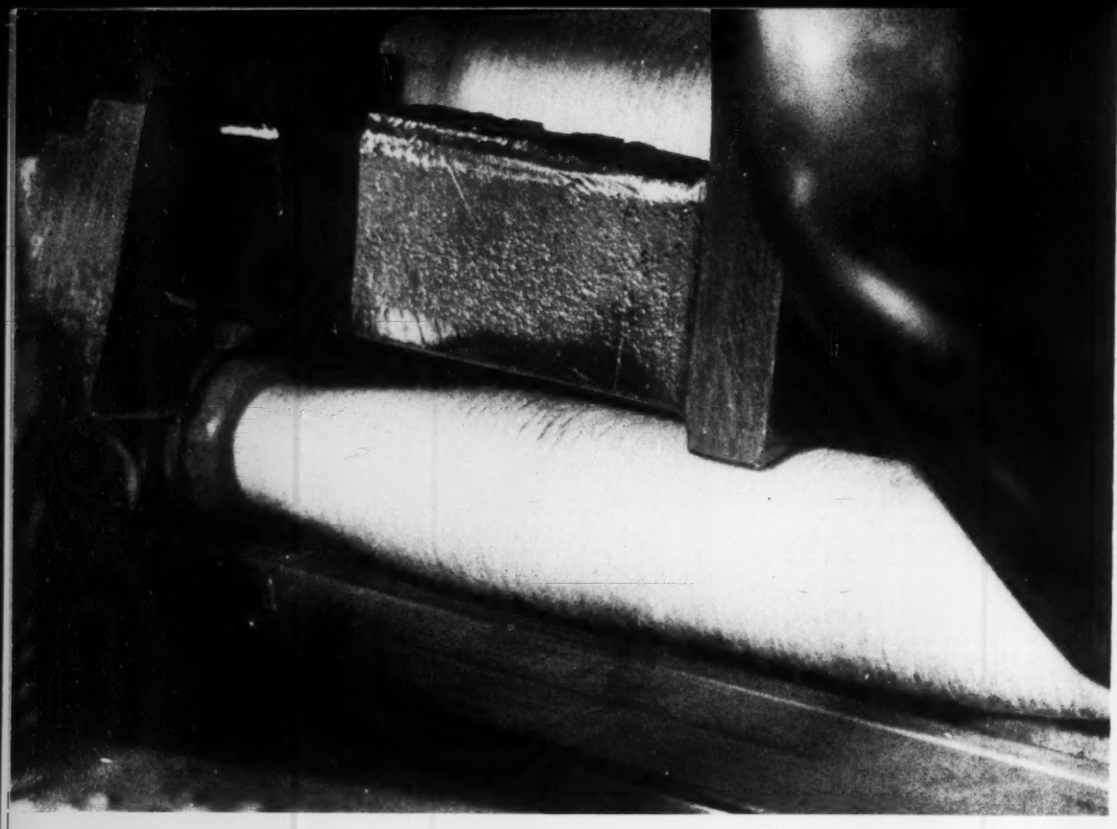


Fig. 4—Bobbin is being transferred without stopping the loom and the new bobbin is moving at a speed of approximately 30 feet per second

operated by the machine being photographed. Commercial moving picture cameras are suitable for low speed work but become inadequate where rapidly operating mechanims are involved. Commercial cameras capable of taking slow-motion pictures are limited to a maximum speed of approximately 200 frames per second, but at higher speeds various difficulties prevent complete satisfaction.

The Edgerton stroboscope, with a still camera, will give surprising results, provided the work can be done in subdued light. Pictures are taken as they would be with a photo-flash bulb. The camera shutter is held open and a very powerful light flashed. In comparison with a photo-flash bulb, however, the stroboscope gives an exposure which is approximately 2000 times as fast; i.e., approximately 1/100,000-second.

Figs. 1 and 2 illustrate graphically the different results obtained with and without the stroboscope. The shuttle in *Fig.* 1 was photographed with a high grade still camera at a shutter setting of 1/1250-second. It is evident this shutter speed is not great enough to "stop" the shuttle completely because the shuttle has moved approximately ½-inch during the time of the exposure. In addition, it was found in taking this picture that the shutter of the camera had to be started fully 20 crankshaft degrees ahead of the desired shuttle position so as to place the shuttle within the view of the camera.

By contrast, *Fig.* 2 shows the same view but with the aid of the stroboscope the exposure time was only 1/100,000-second. With this extremely short duration of exposure, the shuttle is "stopped" in its tracks.

Despite the shortness of the exposure, excellent pictures can be obtained with a comparatively small lens opening. Actinic value of the light is extremely high and of an intensity which has been determined to be equal to that of approximately 2,000,000 watts of incandescent light. The tube used in producing this tremendous burst of light, more intense than ordinary sunlight, is specially constructed and is filled with two rare gases—xenon and krypton.

Without going into the intricacies of the electrical system by which this light is produced, the uses for this apparatus can be outlined. The light is controlled either from the machine being studied or from some independent source. If a series of individual pictures showing the operation of a machine is desired, the light can be driven from a commutator placed upon some part of the machine. By advancing or retarding the contacts of the commutator with respect to the part of the machine to which it is attached, a series of views can be taken. Thus the action of a mechanism can be traced step by step throughout its entire cycle of operation.

Single Film Takes Multiple Exposures

For observations involving simultaneous measurements of displacement and time, the stroboscope can be driven from an independent instrument such as the strobotac or a synchronously driven commutator. Multiple exposures can be made on a single film. Knowing the time between the flashes and having in the field of the picture suitable scales against which to refer the motion of the subject, velocity and acceleration computations are made readily.

In using the multi-flash arrangement, a commutator driven by the mechanism to be photographed sometimes is useful. With it the flashing can be limited to any definite period, avoiding the confusion which might result were the light allowed to flash continuously. The camera shutter can be opened manually and a switch can be closed. The commutator then automatically causes a light to flash at a predetermined rate of speed over the interval which is to be studied. Ease with which the apparatus can be synchronized with the machine and the accuracy with which it can be calibrated make it readily adaptable to all kinds of work.

Experience with the various forms of photographic equipment enumerated has shown that the power

stroboscope and still camera are particularly helpful in the development of textile machinery, but their value in designing other machinery is likewise outstanding. Until this apparatus was available, the movement of shuttles in looms could not be studied without resorting to the expense of slow-motion pictures. Now, however, shuttles that are moving back and forth across the loom 180 times per minute at an average speed of approximately 45 feet per second can be subjected to the most minute observation. By means of single exposure stills, shuttle behavior can be examined during the operating cycle of the machine. By multi-exposure still pictures, the velocity and acceleration of the shuttle can be determined in relation to the timing of other parts of the loom.

Typical Test Arrangement

A typical test arrangement for the study of shuttle flight is shown in *Fig.* 3. The loom illustrated operates at a speed of approximately 162 revolutions per minute; i.e., the shuttle must complete 162 total passages across the loom. On each travel the shuttle covers a distance of 77½ inches and attains a maximum velocity of approximately 45 feet per second, or around 30 miles per hour.

Not only has the power stroboscope accurately determined the characteristics of shuttle travel, but it has made possible the study of various other rapidly moving mechanisms on looms such as the magazine, the center stop motion, and the jumper motion. With its aid, surges in springs during compression and expansion, torsional deflection in driving shafts, and vibration in various parts of the loom have been observed.

An example of studying another loom part is provided by *Fig.* 4, in which a bobbin is shown being transferred in a loom running at approximately 172 passages per minute. This bobbin transfer must occur without stopping the loom and at the particular instance shown the new bobbin is moving at a speed of approximately 30 feet per second.

Designers of woodworking machinery, with its high speeds, find the stroboscope extremely useful. *Fig.* 5 illustrates an open head motor reed cutter traveling at a speed of 7100 revolutions per minute. The chip of wood flying off the cutter itself can be seen in the foreground. Cutters are moving about 90 miles per hour.

Although good results can be obtained by an experienced operator, perfection of this type of photography depends upon the technique of handling the stroboscope, cameras, color combinations, films, development and printing processes. Best work is done in a darkened room and correct diffusion of the light from the stroboscope lamp is important. The flash is so intense that it will be concentrated within a small area unless opalescent glass is placed over the tube or a diffusing lens is placed in front of the lamp. By means of this sort the usable area of the light can be increased greatly.

Painting of objects to be photographed is important. For instance, where dials for time determination are used in the field of the picture, a flat black background with white figures gives the most readable pictures. The same color scheme must be used where multiple exposures are made on a single film for velocity studies.

Lens opening of the camera depends upon the number of lamps, the distance of the lamps from the object to be photographed, the darkness of the room in which the work is being done, and the number of exposures that are to be made on one negative. With two lamps

(*Concluded on Page* 94)

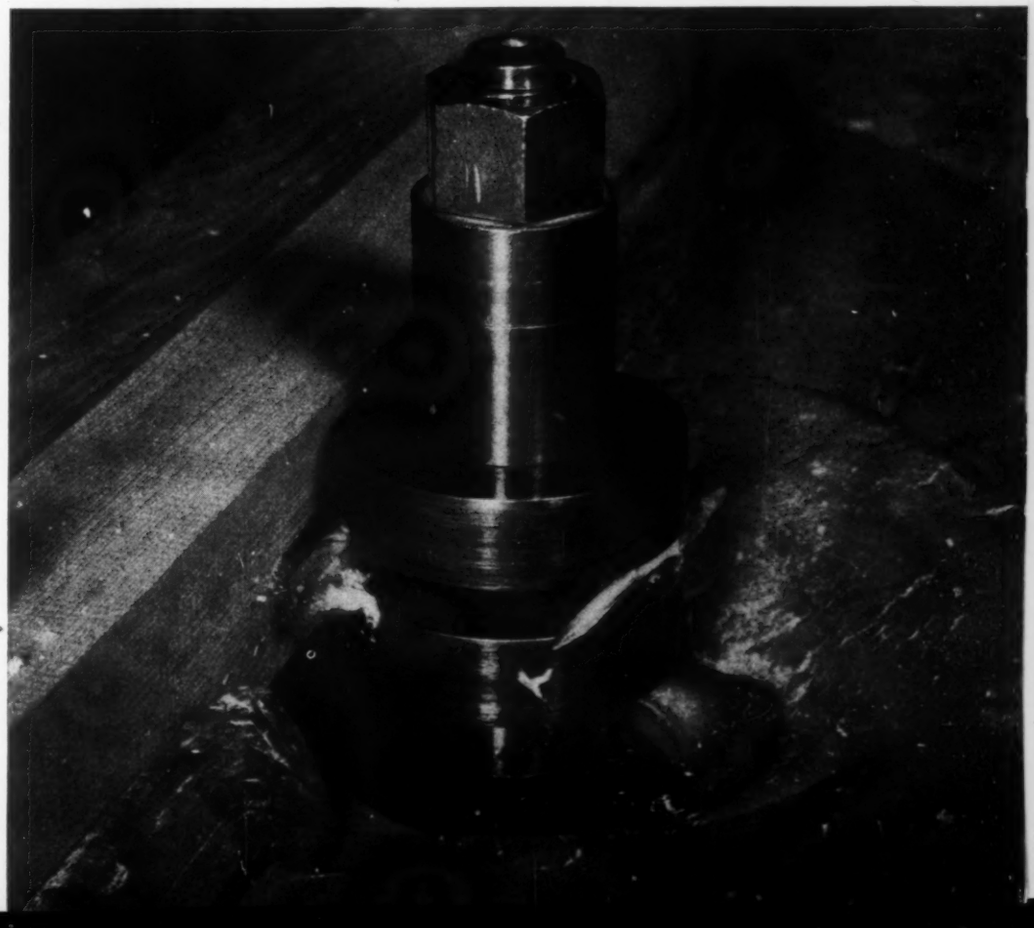


Fig. 5—An open head motor reed cutter traveling at high speed. Chip of wood flying off may be seen in foreground

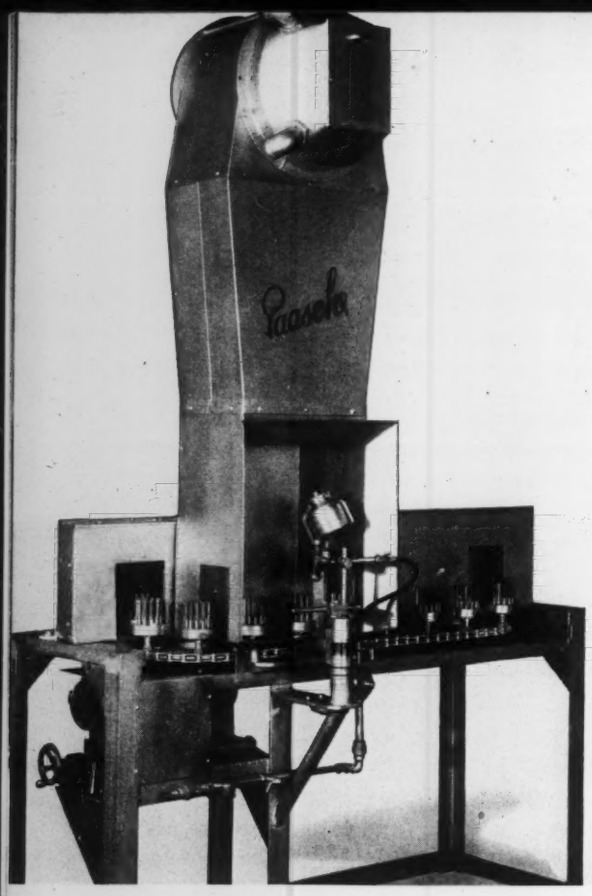


Fig. 1—Chain with extended pins is utilized for conveying in this automatic spraying unit. Note small pinion engaging to revolve fixture during spraying

By George Z. Griswold

Building Chain Cove

UTILIZATION of chain for built-in conveyors in machines presents problems to the designer which call for an entirely different approach than that taken when chain is to be used for power transmission. Whereas chain power drives have been characterized lately by increased speeds, smaller pitch, and more sprocket teeth, conveyor chains move slowly and their form varies according to their carrying functions. Hence the actual driving mechanics become an incidental aspect of the design, instead of the basic one.

Table I, listing factors entering into the choice of built-in chain conveyors, indicates the specialized nature of the problems faced. But after these questions have been answered and the general type of chain chosen in the light of them, there remains the matter of selection on the basis of the chain pull imposed in relation to the maximum working loads of chain available. This pull is the force required to move the weight of the chain and material and to overcome the frictional resistance of the chain parts on the runways.

The following formulas may be used in calculating total chain pull, and proper chain may then be chosen easily. In these formulas, H is the horizontal projection of conveyor length in feet; V the vertical projection of conveyor length in feet; W the weight in pounds of material handled per foot of conveyor length; P the weight in pounds per foot of all moving conveyor parts; and f the coefficient of friction of the chain on the runway. In the case of sliding steel on iron or steel, this value is 25 per cent, while rolling friction is 15 per cent. This coefficient is larger if other material is in contact with the runway. For horizontal conveyors,

$$\text{Pull} = fH\ (W + P)$$

When the lower strand of the conveyor drags on the runway, $2P$ is substituted for P. For vertical conveyors,

$$\text{Pull} = V\ (W + P)$$

For inclined conveyors, or inclined combined with horizontal, naturally

$$\text{Pull} = fH\ (W + P) + V\ (W + P)$$

Most popular types of conveyor chain at present are accurately made and highly finished, giving them flexibility and adaptability to many different types of applications. Besides finished steel roller chain which is also used extensively for power transmission, special types have been developed primarily for conveyor purposes and include extended pitch finished steel

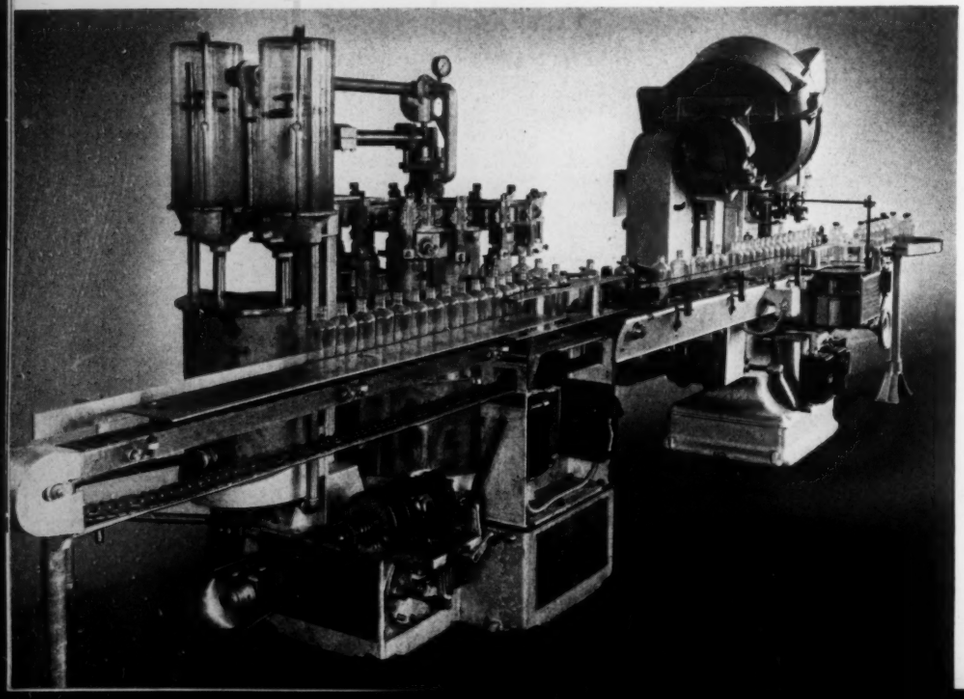


Fig. 2—A platform conveyor chain operating between a rotary vacuum filling machine and a bottle capper. Cut tooth sprockets are used

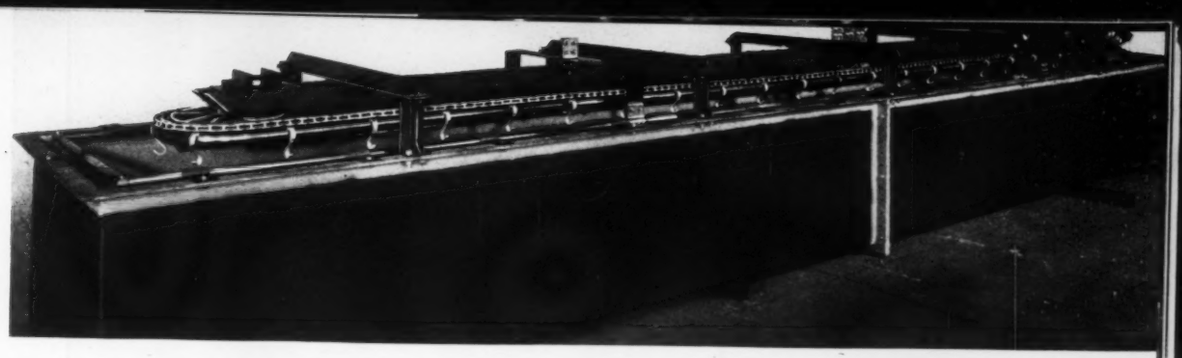
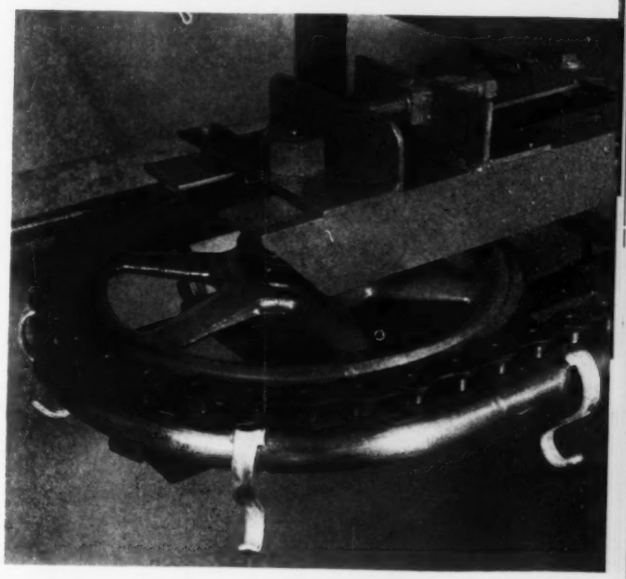


Fig. 3—Operating in a horizontal plane, chain on this semiautomatic plating machine has a hollow pin for insertion of carrying hooks. Fig. 4—Below—At each end is an idler around which chain turns

veyors into Machines



roller chain, straight flat-top finished steel roller chain, and universal carrier flat-top chain. The latter, because of its construction, can pass around bends in both planes.

Finished steel roller chains in standard sizes are suitable for many applications and are made in various pitches, all relatively short, permitting spacing attachments for almost any conveying conditions. Short pitch chains also will operate over smaller wheels and therefore can be used in more limited quarters. These standard chains can be furnished with extended pins from which either the material or attachments may be affixed or suspended. An example is shown in *Fig.* 1, where an automatic spraying unit utilizes chain with extended pins to hold a small pinion which engages to revolve fixtures during the spraying operation.

A variation of standard sizes which is proving popular is known as extended pitch conveyor chain, the pitch usually being double the standard for chain with the same joint construction. Some of the chains are made with large diameter rollers but where these rollers are not needed for rolling action, some extended pitch chains are made for sliding with straight side bars.

A comparatively recent development is flat-top conveyor chain made of finished steel roller chain, having such advantages as accurate pitch, exceptionally close tolerances and uniform top plates made of either ordinary or stainless steel. On canning and packaging machines, of course this type has been found so useful as to be almost standard. *Fig.* 2, for example, shows platform conveyor chain operating between a rotary vacuum filling machine and a bottle capper. Accurate filling is maintained at high speeds. With this type of chain, cut tooth sprockets are used. One of the most interesting applications of flat-top conveyor chain is that in *Fig.* 5, where six strands are used on a gas-electric industrial truck.

Figs. 3 and 4 illustrate how conveyor chain may be specially made for particular applications, in this case for carrying parts through a semiautomatic plating machine. Operating

Fig. 5—Below—An unusual application of built-in flat-top conveyor chain on a gas-electric industrial truck

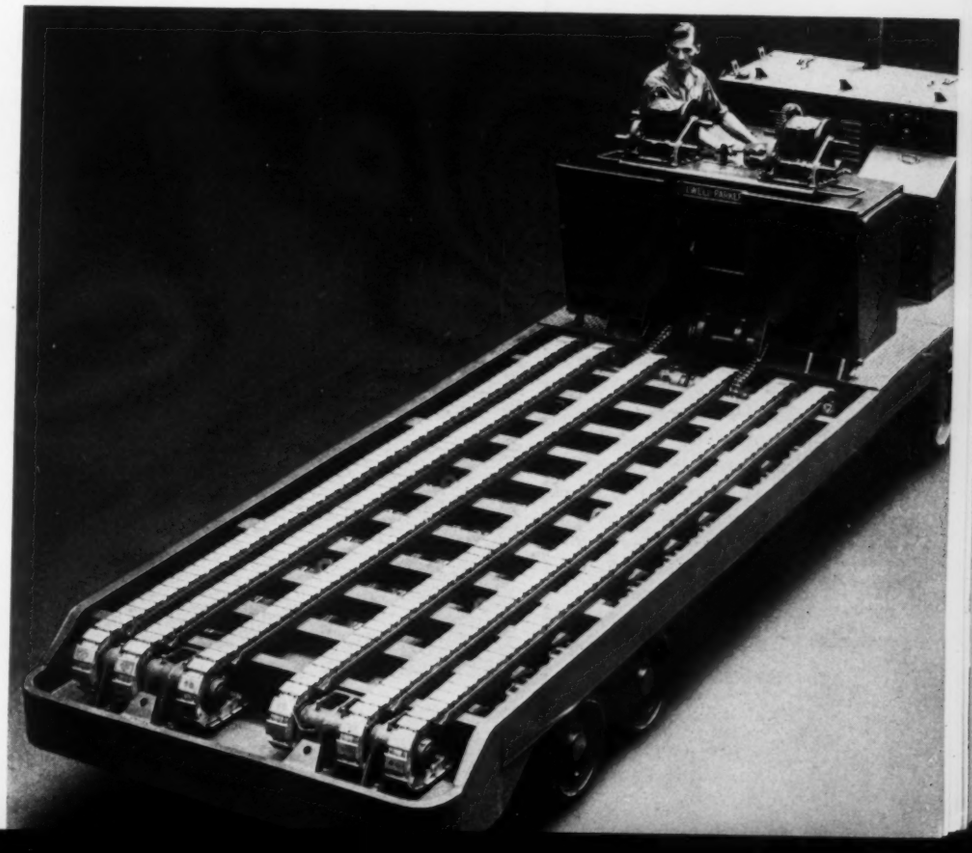


TABLE I

Factors Influencing Design of Built-in Chain Conveyors

I. Function of conveyor.
   A. Size, shape and dimensions of product being carried. Is exact timing or spacing of pieces necessary?
   B. How attach or carry piece?
   C. Special attention needed to prevent marring?

II. Type of chain.
   A. Finished steel, malleable iron, cast steel or woven wire supported by steel chain?
   B. Standard chain, with or without standard attachments? Grippers or trippers?
   C. Pitch, considering load, chain weight, and pitch for desired spacing.
   D. Chain materials—heat or corrosion resistant?

III. Support or bed for chain conveyor.
   A. Flat plate drag conveyor permissible?
   B. Built-in rollers to carry load or reduce friction?
   C. Do loads impose chain twist?
   D. Supplementary supports needed for return conveyor?

IV. Sprocket design.
   A. Standard or special?
   B. Size for desired speed and clearances.
   C. Material.

in a horizontal plane the chain has a hollow pin for insertion of attachment hooks and is stud bushed, without the conventional rollers. At each end of the tank is an idler wheel, *Fig.* 4, around which the chain turns. Wear is compensated for by adjustment of these idlers and chain speed can be regulated to the work, ranging from one-half to five feet per minute. The attachment hooks ride on the cathode bar which is kept properly lubricated by grease cups, and are so designed that the load point is directly below the center line of the pin inserted in the hollow pin of the chain. The hook is thus advanced along the bar at a uniform speed, without jerking. Spacing possibilities of the hook are infinitely variable in multiples of the chain pitch—two inches.

Universal Chain Double Articulated

One of the most recent developments in conveyor chains is universal carrier chain with flat overlapping top plates, presenting a continuous full-width surface as the chain passes around horizontal curves. This chain is made with a double articulation for operating over sprockets in both horizontal and vertical planes, thus permitting the return run to be located directly beneath the carrying run, eliminating use of dead plates or turntables at turns. Conveyors using this chain can be made to follow practically any desired path in clearing posts or other obstructions, yet will operate from a single drive.

Two ways in which chains may be used as conveyors are shown on the wrapping machine in *Fig.* 6. The package infeed consists of a continuous chain between the lugs of which the unwrapped packages are placed by the operator. Packages are carried to the elevator of the machine, from where the wrapping begins. Chain is used because packages might be too slippery or heavy to be fed onto the elevator by other conveying means, or might interlock if they pushed each other, as in the case of tapersided boxes. When high lugs have to be used an intermittent chain feed is supplied. Lugs otherwise would not clear the elevator but with intermittent motion time is allowed for the elevator to rise far enough to prevent interference between itself and high lugs.

Conveyor Chains Versatile

An overhead chain carrying individual packages through the folding line is provided in this machine when packages are of such a shape that they cannot push each other without interlocking or are not firm enough to prevent damage. Heat sealed packages also require an overhead chain because the machine has to be self-clearing or the packages between the heaters would be scorched.

In another interesting application, two distinct conveyor systems are used, in a machine handling dairy products containers. Because stainless steel is used throughout the unit, the roller chain employed is also stainless. One conveyor unit operates in a horizontal plane and carries containers through a paraffin cooling chamber. The other consists of two matched strands with special attachments, operating horizontally, and one strand of another size chain with attachments and outboard rollers. The latter strand operates vertically beneath the other two. All three strands must be perfectly matched for accurate timing and accuracy of pitch is maintained within .007-inch per foot.

It can be said that limitations on chain conveyor applications are few, providing the designer is completely informed regarding the requirements of the application. Where standard chain and attachments are not suitable, special equipment usually can be built by chain manufacturers.

For their co-operation in the assembly of illustrations and information in this article the editors wish to thank: Baldwin-Duckworth division, Chain Belt Co. (*Figs.* 3 and 4); Link-Belt Co. (*Figs.* 1 and 5); Package Machinery Co. (*Fig.* 6); Peerless Machine Co.; Pneumatic Scale Corp. (*Fig.* 2); The Whitney Chain & Mfg. Co. (*Fig.* 2).

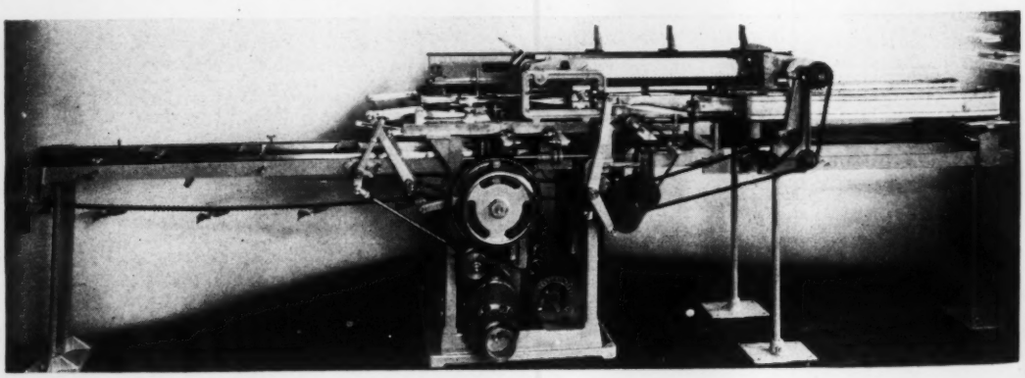
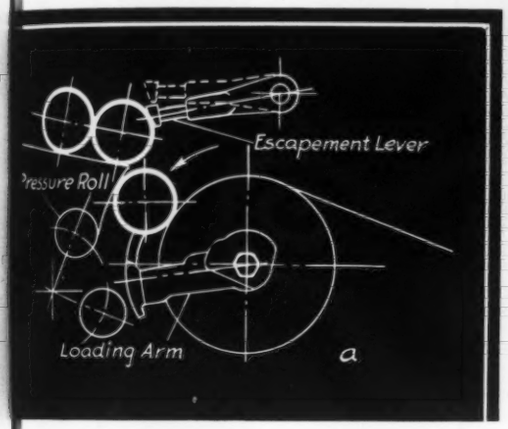


Fig. 6—Wrapping machine uses conveyor chains in two ways, for the package infeed and for overhead conveyor carrying packages through folding line

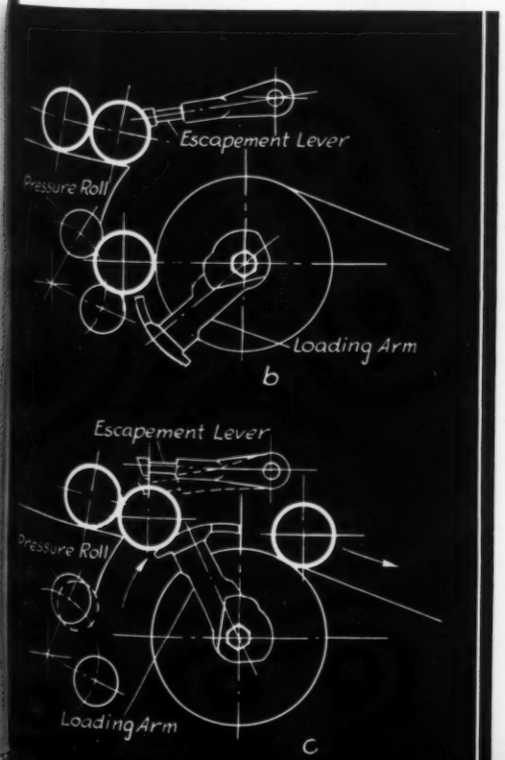
Fig. 1—Almost surrounded by operating parts workpiece is loaded and ejected at top

Fig. 2—Schematic diagram of loading cycle. At (a) workpiece is following loading arm into grinder. At (b) workpiece and pressure roll are in position. Bottom (c) has pressure roll relieved, loading arm raised, finished work in discharge chute and escapement lever raised to allow next workpiece to follow arm into grinding position



Loading and Unloading Accomplished through Same Path

By H. L. Blood
The Heald Machine Co.



AUTOMATIC loading of the centerless internal grinder as shown in *Fig.* 1 requires that the loader be standardized and yet be adapted easily to handle almost any size and type of work within the capacity of the grinder. Almost entirely surrounded by other units, the work must be fed into place without cramping the design of any other part. This is accomplished through hydraulic control of a loading arm which receives and ejects work at the top of the machine.

Since the work is rotated between three rolls while the bore is being ground, in many cases it is desirable to square up the work by its back face, especially when the work is narrow. This is accomplished by slightly skewing one of the rolls, which makes it press the work endwise against a backing plate as the work and rolls rotate.

Interference with loading from the left in *Fig.* 1 would be caused by this backing plate and gage. Also, it is desirable to keep the right end of the work clear to use the shortest possible wheel spindle. The roll below the work should be accurately and rigidly mounted which precludes the possibility of moving this roll out of the way and allowing the work to drop out.

Only one possibility remains, to unload and load through the same

path, that is, the finished work should be discharged upward and new work should then be brought down into position from above.

It was found impractical to drop the work into place by gravity because it would bounce out of position and the impact might damage the accurately finished rolls and bearings.

These considerations led to the design of the loader shown schematically in *Fig.* 2. A loading arm, carrying a curved blade, is lowering a piece of work into position in *Fig.* 2*a*. The pressure roll is cammed back at this time. *Fig.* 3 also shows this position.

In *Figs* 2*b* and 4, the arm has reached its lowest position and the pressure roll has been allowed to swing forward under spring pressure, holding the work against the two fixed rolls.

After the arm has swung up to eject the finished work, which may be seen rolling down the discharge chute in *Fig.* 2*c*, a new piece of work is released from the loading chute by an escapement lever. Resting on the loader blade, the work will follow the blade into position on its downward swing. This position is shown clearly in *Fig.* 5.

Loading device is adjustable for a wide range of sizes and shapes of work with a minimum changing of parts. It operates so rapidly that a finished piece is replaced by a new one without stopping the table, which simply makes an extended stroke while the loader is operating and returns immediately to start grinding a new load.

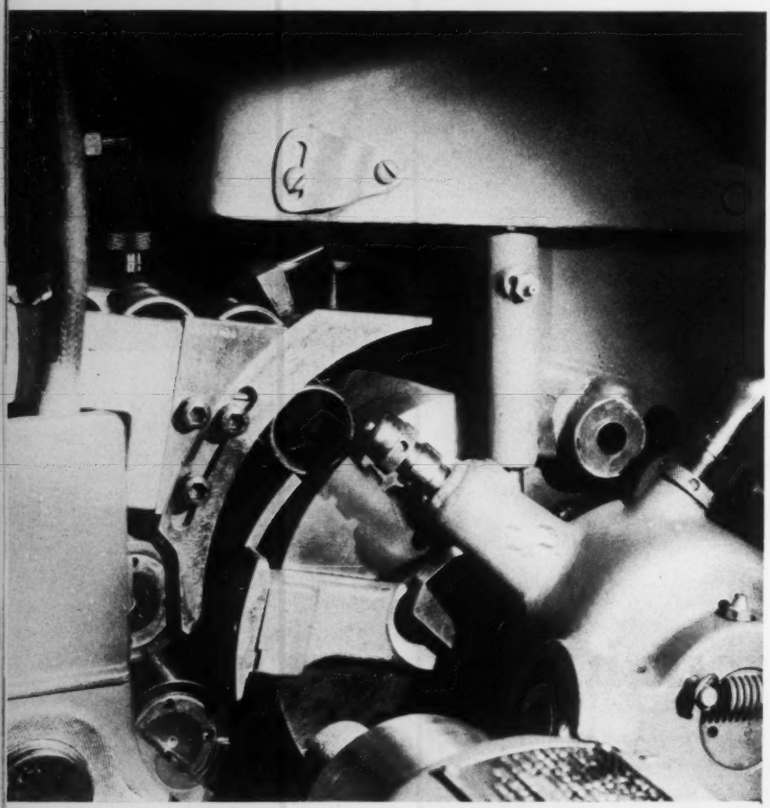


Fig. 3 — Above — Workpiece follows loading arm into grinding position

Controlled by Hydraulic Vane

Operation of the loader at the proper time presented problems. Cams and gears were objectionable due to the number of parts involved and because adjustments would be required to suit different jobs. Therefore a hydraulic vane was provided, as shown in *Fig.* 6, to swing the loading arm up and down and a simple way of controlling the vane was worked out. At the end of the grinding cycle when the table starts to move out, the table piston covers its normal exhaust port, after which the oil ahead of the piston can escape only by operating the vane which raises the loading arm. When the table reaches the end of its stroke the oil to the cylinder is reversed, which reverses the motion of the vane, lowering the arm and placing a new load of work in position as the table comes in. Thus the timing is positive and a separate reverse valve is not required for the vane.

Approximately the same surface speed for work of any diameter, unless the proportion between bore and outside diameter is very unusual, is provided by driving the large work-feed roll by a gearmotor. This

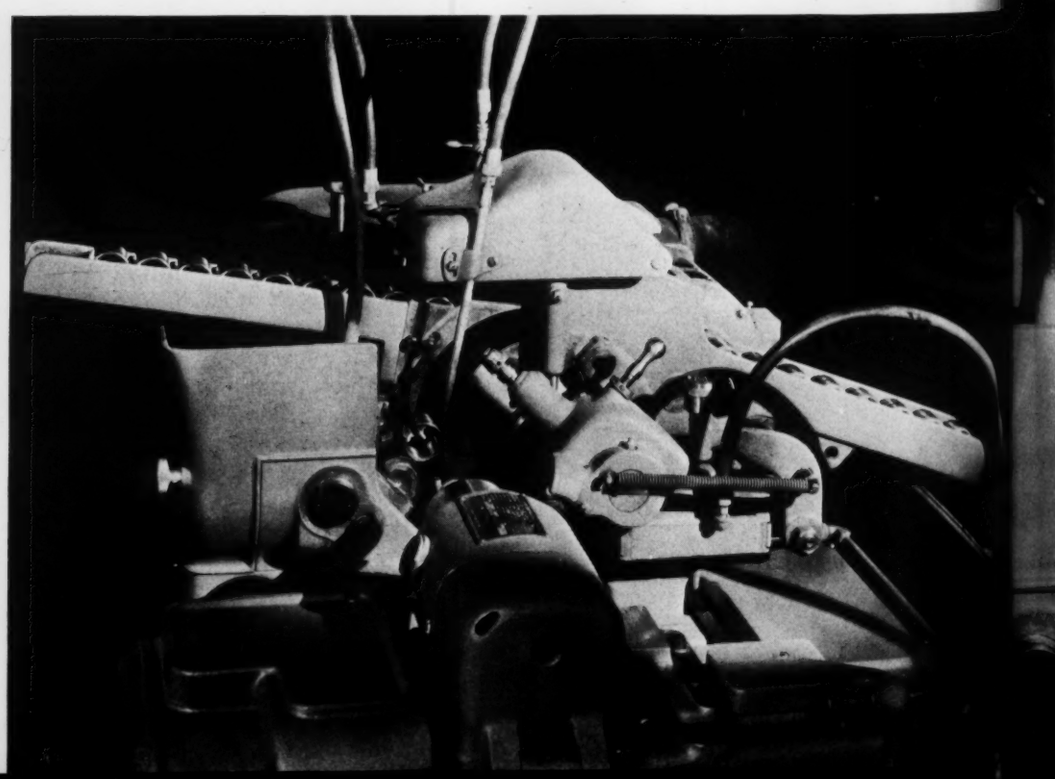


Fig. 4—When workpiece is in position, pressure roll holds it against two fixed rolls

driving arrangement is illustrated in *Fig.* 7, providing a compact self-contained unit.

When grinding the bore of one piece at a time by the centerless method, normal variations in the outside diameter cannot affect the bore diameter, provided the bore is controlled by an automatic plug gage. However, if two or more pieces are ground simultaneously and so located that all pieces in a load have the same wall thickness, it will readily be seen that if the bore of one piece is ground to, say, plus or minus .0001-inch the bore of the adjoining piece will be ground to the same tolerance *plus* any difference between the outside diameters of the two pieces. Since it is generally desired to hold the bore tolerance as close or closer than the outside diameter tolerance, another problem was presented.

The solution was found in supporting the work at two points equidistant from the vertical line, which is equivalent to laying the work in a V-block. Variations in the outside diameter raise or lower the work, but

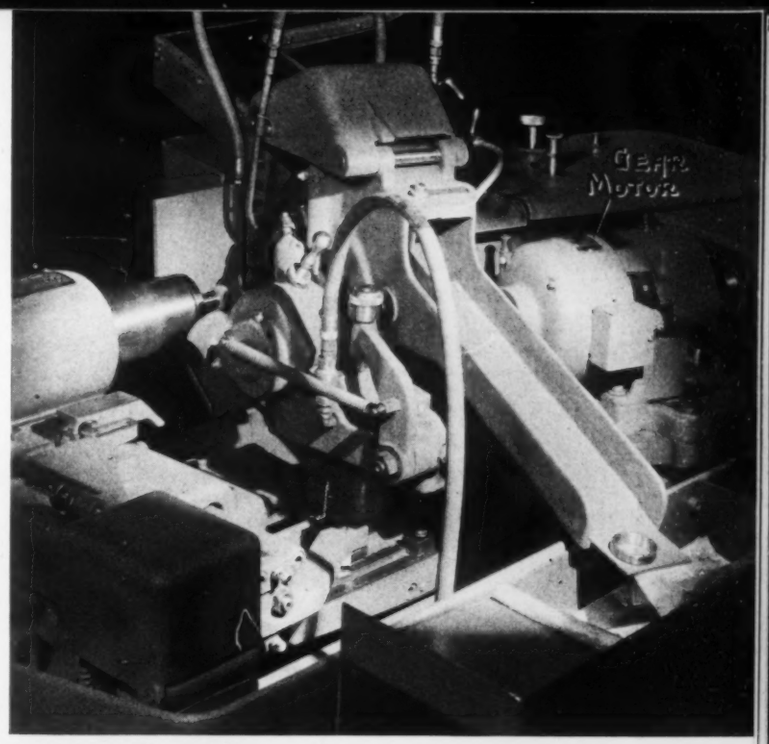


Fig. 7 — Above — Gearmotor drives large roll to provide constant grinding speed of workpiece

Fig. 5 — Below — After ejecting finished piece, loading arm receives next piece to be ground. Sliding past the arm, piece follows into position

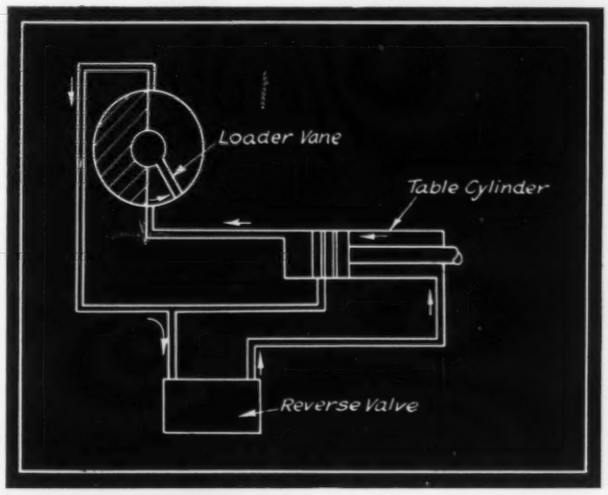
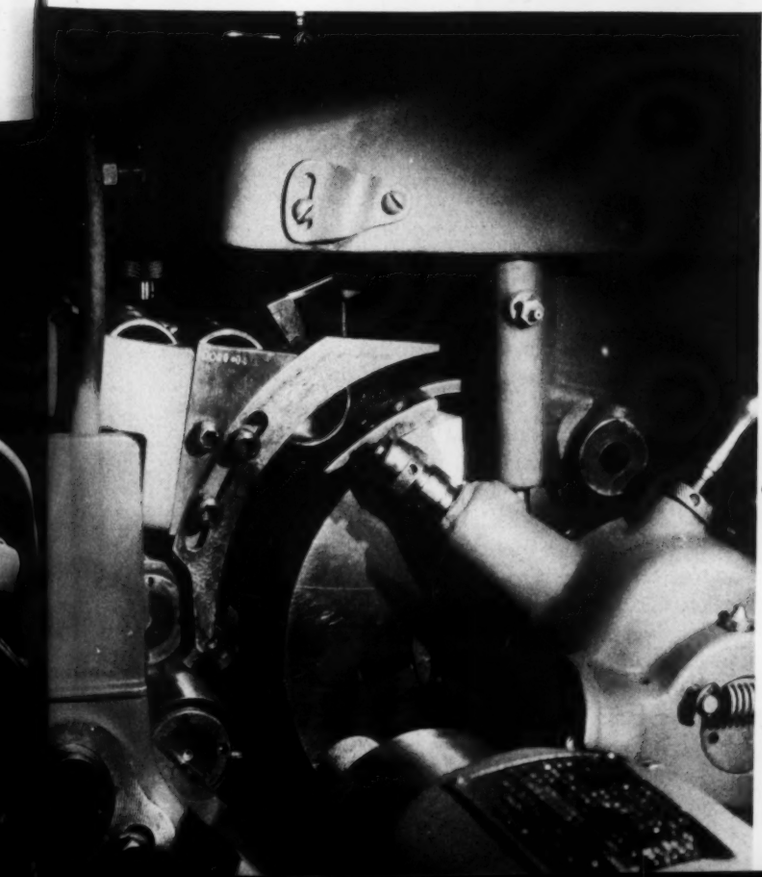


Fig. 6—Right — Hydraulic circuit for operating the automatic loading device



have practically no effect on the size of the bore since the wheel is fed along the horizontal center line. The two points which locate the work are of course the two points of contact with the fixed rolls. The arrangement of work, rolls and wheel is shown in *Fig.* 1. This arrangement makes it possible to grind several pieces at a time to close limits in spite of the variations which normally occur in the outside diameter of the workpiece.

As the centerless internal grinder is entirely automatic, it is usual for a number of machines to be tended by one operator. An automatic stop is therefore provided in the form of a limit switch which is opened by the wheelslide when the wheel has been worn to the minimum size. This switch, seen in the lower right of *Fig.* 4, is wired in multiple with a second limit switch which is opened when the table is in the "run out" position, so that the next time the table runs out both limit switches are open at the same time, disconnecting the motor which drives both the pump and the wheelhead. The pump, acting as a brake, stops the machine quickly while the table is in the out position, ready for replacing the wheel with a new one in minimum time.

One of the severa types of surface analyzing machines and devices demonstrated at the recent conference on surface finish. This Brush analyzer measures minute irregularities and records them in graph form

Which Surface Is Best?

CURRENT interest in surface finish and its relation to design was amply indicated by the recent three-day conference on "Friction and Surface Finish" held at M.I.T. Leading engineers with aircraft engine companies and manufacturers of many other types of machines, as well as representatives of oil companies and research engineers, took part in the conference through the presentation of papers and participation in round-table discussions.

General agreement in regard to the particular type or class of finish most suited to reduce friction and wear while at the same time meeting other conditions imposed by specific applications was not reached. Nor was any one type of surface measuring device given uniform approval. If for no other reason, however, than to disclose the sometimes wide differences in opinion and to try to reach common understanding, the conference served an extremely useful purpose.

Definite Standards Needed

One of the most timely discussions as far as designers of machinery are concerned—inasmuch as the specification of surface finish is in their hands and thus far no definite standards have been established—was presented by O. R. Schurig, General Electric Co. This discussion was especially pertinent because a tentative standard has been published recently by the American Society of Mechanical Engineers based upon one system of surface measurement only, whereas it is Mr. Schurig's contention that no one method gives an adequate measure of surface quality. This view also was held by other engineers present and it therefore is likely that the tentative standard (discussed at more length in MACHINE DESIGN, June, page 82) will undergo considerable revision before finally being promulgated as an accepted standard.

Among the points to which reference was several times made in connection with the proposed standard was the question whether root mean square height of surface irregularities, used in the standard, gives a true measure of surface quality. The possibility was put forward that this method of measurement might be more satisfactory if qualified by reference to the type of surface finish to be checked, which procedure may be adopted. Bearing upon this, S. Way of the Westinghouse company pointed out that specification of a single parameter associated with roughness should always be supplemented by specification of the method by which the finish is produced.

Extremely smooth nitrided surfaces running together received favorable comment. It was pointed out, however, that bearing surfaces of this material have been found to fail if subject to temperatures as high as 925 Fahr. due to the effect on the surface hardness of the material.

Superfinish, the type of finish developed and adopted for many of its parts by Chrysler Corp. and also utilized by an increasing number of machinery manufacturers, was given much credit for reducing friction and wear. It does not seem that this type of finish is acceptable to all however, some engineers present claiming that a less smooth surface requiring a run-in period proved more satisfactory for their particular conditions.

Photoelastic Analysis in Commercial Practice

By R. E. Orton

Part V

Acme Steel Co.

POSSIBILITIES and extent of errors in photoelastic analysis require consideration to determine the degree of accuracy with which actual commercial applications may be treated. Among the factors affecting errors due to variations in fringe patterns are creep under load, edge effect, temperature change, initial stress, accuracy of model with respect to fillet shapes, scratches, etc.

Considerable discussion may be found in photoelastic literature on the errors introduced by strain and optical creep. "Strain creep" is defined as increase in deformation with time while under a fixed load, and "optical creep" likewise as change in fringe value with time, while under a fixed load.

Tests were made by the writer on the specimen shown in *Fig.* 19, Part IV. Model of BT-61-893 annealed Bakelite was loaded to read 17 fringes. An hour later the fringe value had increased ⅞ an order, or 3 per cent, and the deflection had increased 10 per cent. This phenomena is reported as being rapid at first, then gradually reducing to a slow rate. In this case nearly 60 per cent was observed to occur in the first ten minutes. The effect is also roughly proportional to the stress.

This specimen was .324 inch thick, loading therefore being to 52½ fringes per inch thickness. Therefore, if the recommended level of 42 fringes is adhered to, and observations made in the period from ten minutes after loading to thirty, the total optical change from the beginning of observation to the end will only be ½ per cent. Calibration specimen should likewise be held 4 or 5 minutes at each step, carrying the test to the fifth order. This will bring the specimen to approximately the fifteen minute reading of the model, reducing the maximum error to ¼ per cent. With the analysis carried through in this fashion it is apparent that optical creep may be ignored. The method of loading, however, must be such as to take up the deformation without appreciable change in load value.

The material undergoes a recovery in optical value and strain on release of load, the action again being rapid at the beginning becoming less with time. The above phenomena varies somewhat between different specimens of Bakelite, and also with the annealing history, being reduced by longer anneals.

Tests were also made on this model to determine the optical proportional limit, that is, the point at which the increase in fringe value is no longer proportional to the load. Model was progressively loaded and load read at each fringe, up to a level of 37.5, giving a stress of 86 × 17.5/.324 = 4650 pounds per square inch. No errors due to lack of proportionality could be detected. This indicates the optical proportional limit higher than 54 fringes per inch thickness for this material. There was no indication, either, that the strain yield had been passed at this load.

Edge Effect Is Troublesome

Probably the most troublesome error is "edge effect." The rate of development of this phenomena varies widely between different specimens, appearing very little in some even after 24 to 48 hours, and in others within an hour. It is probably due to a drying out along the fresh cut edges, causing a change in the optical effect. The usual result is to produce a heavy fringe, or row of closely spaced fringes, roughly parallel to the edge. If it so happens that this pattern aligns itself with the stress pattern it may be difficult to distinguish between them. The phenomena is particularly troublesome when dealing with very fine details, and shows up markedly in large magnifications. As a general thing the penetration will not exceed five to ten thousandths, and will reach this within a few days.

At times the edge effect will not show up as a pattern, but instead may completely wipe out the ends of the stress contours, or may displace them, or hook them back in a characteristic fashion. In practically all cases where the detail has been wiped out, or so distorted as to make direct reading impossible, extrapolation may be resorted to with but very little error. The possibility of an edge effect should always be borne in mind and looked for, otherwise serious errors in reading may occur. Matters should be arranged to permit loading the model as rapidly as possible after making the final cuts. For this reason it is best to rough down in filing to about .015 inch from the final contour, and then finish up.

Edge effect is shown in *Fig.* 23. Ends of the fringes in the center hook back in a peculiar manner. Observation discloses a slight difference in the texture of the

model over this region. This region measures .007 to .008-inch. Additional bands also appear at the extreme left.

Experiments were made to determine the requirements of normality of illumination. Apparatus was moved out of line and the model tipped into various positions. In all cases it was found that when the alignment was out sufficiently to affect the pattern by even a few per cent, the picture had so lost clarity as to make the determination very difficult. The conclusion is that if the apparatus is sufficiently close to alignment to appear straight to the eye, and the model brought into the position that gives the greatest clarity (after refocusing), the alignment is sufficiently accurate for commercial work.

Effect of Load Eccentricities

Question of the effect of departure from assumed plane stress distribution is of considerable interest. If the stress directions vary through the model the effect will be to lighten up an isoclinic band. Variations in the stress intensity, since the retardation of a ray component is a cumulative effect, will change the fringe order. The result will be to determine the *mean* principal stress, provided the stress direction does not vary too much through the model. To avoid excessive departure from plane stress it is advisable not to use too thick a model, and to use reasonable care in placing the load.

Theoretically, eccentricity of load application should make no difference in the pattern since the mean stress is not changed. Observations disclosed that small variations from parallel of the load pull produced no appreciable difference. Larger eccentricities, however, affected the clarity of the image. It is sometimes well to adjust the direction of pull to see if a clearer picture can be obtained.

One-half of a typical calibration specimen is illustrated in *Fig.* 24. This shows what may be expected in the way of eccentricity of load. The black band centralized around horizontal center line is at the fifth order. Specimen is of the same dimensions as shown in *Fig.* 15, Part III. The bottom is approximately at 4¾ of an order, the top being 5¼. This is a net difference of ½ order or 10 per cent, indicating an eccentricity of load of only .002-inch. End lacks clarity due to omission of final polishing.

There is some variation in the stress optical effect with change in temperature. In the case of Bakelite BT-61-893 it amounts approximately to ⅞ per cent decrease for each increase of 10 degrees Fahr. from 75 degrees; and the reverse for the other direction. In the writer's case all work was done in an air conditioned room with the temperature held between 70 and 80 degrees, so that the maximum error from this source was ½ per cent, and could safely be ignored. Where wide swings of temperature are encountered, however, this effect must not be overlooked. It should not be forgotten also, that Bakelite is a poor conductor of heat and if the model has been in another room at a different temperature it will take some time for it to come to the temperature of the room in which the photoelastic observations are being made.

With some of the photoelastic materials being used today the temperature effect is marked. One popular material, in the unannealed condition, is reported to show a decrease of 12 per cent for an increase of the temperature of 10 degrees from 75 degrees Fahr. In the annealed form it is reduced somewhat from this value; but is still quite high. Also, variations in the annealing produce considerable differences in the effect, as well as in the optical coefficient, making it necessary always to anneal a calibration specimen with each model.

"Initial pattern" is another phenomenon that varies widely with different specimens. In a few cases the pattern may be low enough to permit using without annealing. In other cases it may even take a double anneal. In the writer's experience it has always been possible to reduce this initial pattern not to exceed ¼-order, and it has usually been less than this. If working to a fringe level of 10½ this would mean that the maximum possible error from this source could not exceed 2¼ per cent. Since in general the maximum stress will not occur at the maximum initial pattern, the error from this source should generally be considerably less than 1 per cent, and may be ignored.

This initial pattern comes chiefly from two sources, the manufacture of the material and model making. The first has been shown not to be related direct to an initial stress pattern, as was formerly supposed. It has been shown that the pattern does not meet the requirements of a balanced stress system. There is, therefore, considerable doubt as to whether it may be subtracted

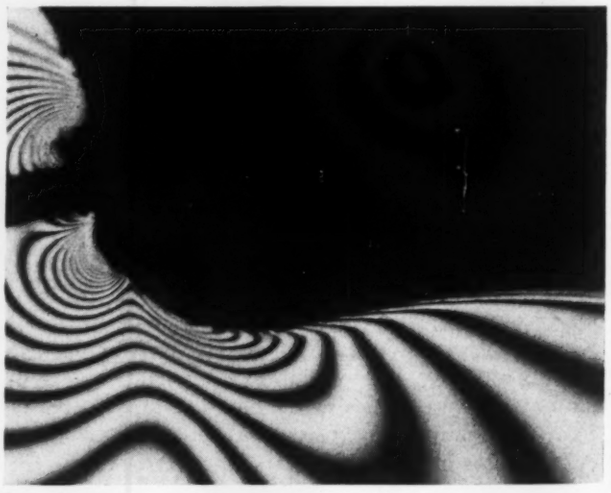


Fig. 23—Edge effect is readily observed in this pattern by the peculiar hook back of fringes. Enlarged 15 diameters

from the loading pattern. Even if it could it would be necessary to consider the relative directions at any point between the initial and the stress pattern, as shown by *Fig.* 5, Part I*. If the patterns do combine in this fashion, it should be noted that if the directions differ appreciably, for the relative magnitudes possible at the point of maximum stress, the resultant will differ by but a very small amount from the stress value. Also, the suggested calibration practice of ignoring the first step still further reduces this error, eliminating

*MACHINE DESIGN, March 1940, page 34.

it entirely in the calibration if the initial pattern isoclinic is parallel to the centerline of the test specimen.

Initial pattern in model is probably due to overstressing in making. Machining that introduces a pattern should be done at a slower speed and feed, until the pattern produced is not objectionable. Filing, if done with reasonable care, will not produce a pattern.

It has been the desire of the writer in the preceding discussion to bring to the engineer engaged in machine design the realization that photoelastic analysis will push forward the frontier of his design ability. Further, that by the methods described it becomes an efficient and economical method of solving those problems that will not yield readily to other methods.

It should be understood that this is not a tool for the novice, nor will it place the uninstructed, by a wave of the hand, onto a plane with the informed. Rather is it to be used by the advanced engineer, to

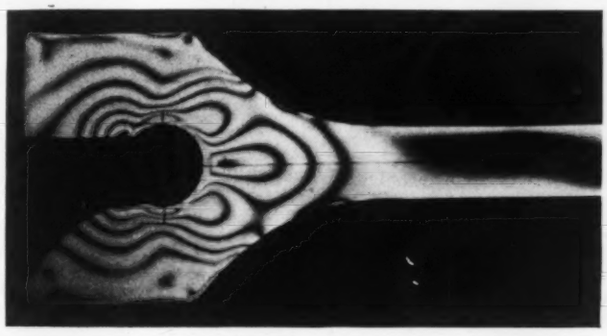


Fig. 24—Eccentricity of load is indicated by black band being off center. Enlargement is two diameters

assist him where other methods fail. This it will do with an accuracy that will more than meet the requirements of commercial work.

Inasmuch as the shapes to which photoelastic analysis is applied will frequently involve "stress concentrations," the following references are given. H. F. Moore in *Metals and Alloys,* May and June, 1939, brings out that the higher the mathematical stress concentration the farther the material stress departs from the mathematical figure. He also discusses the practical importance of inelastic action. Westcott in *Mechanical Engineering,* November, 1938, gives an excellent resume of the work of some other experimenters on this and allied subjects. There is an interesting discussion of the effects of grain size on the initiation and propagation of a fatigue crack.

From the *Transactions of the A. S. T. M.,* 1930, by R. R. Moore, H. F. Moore, Kommers, Townsend, Gillett and Jasper, a very extensive coverage to that date, on this and allied subjects is given. Among other matters, this article points out that a narrow crack oriented at right angles to the stress direction would have a mathematical stress concentration increasing without limit as the width of the crack decreased toward zero. It will be realized at once that the departure of the actual stress from this figure will be very wide. However, it should not be assumed from this that the actual concentration effect is small. On the contrary the effect is very large, but not as large as the mathematical figures would indicate. Moreover, in this case, the effect of different materials and heat treatments on the stress developed will be considerable.

While the approach of photoelastic materials to the mathematical is very close, in the case of such extreme stress concentration as this even the photoelastic materials will show some adjustment. *Reprint No. 9, University of Illinois Engineering Experiment station,* 1936, H. F. Moore, discusses in particular inelastic action. The relation between grain size and concentration notch is also discussed here.

An article by A. M. Wahl, MACHINE DESIGN May, 1940, gives an excellent discussion of the present concept of the "stress concentration" factor and of its application to spring materials. The "size effect" is also discussed.

In conclusion the reader is urged to study further the theory of elasticity. With the aid of this knowledge, photoelastic analysis becomes an even more powerful tool. A recent excellent article by J. Delmonte* is also recommended for its general discussion of creep and some other characteristics of plastics. It will assist toward a better understanding of the nature of the materials used for models.

A list of the notations used in this series of articles appears below.

Nomenclature

α	Inclination of the principal directions measured from the X axis to the direction of S_1
β	Inclination of the principal directions of the resultant of two superimposed stress systems
γ	Phase angle of the light wave, or the phase difference of two waves
θ	Relative inclination of the principal directions of two superimposed stress systems
ω	Angle between the plane of polarization and the S_1 principal direction
$A.U., A^\circ$	Angstrom unit, equals 10^{-10} part of a meter
B	$B=l/d$
H	Calibration value of model material, pounds per inch per fringe
I	Moment of inertia of cross section
M	Bending moment
P, R, T	Total applied loads. In calibration P is taken as the load per fringe
Q	The principal stress difference, (S_1-S_2)
S_1	A principal stress, usually taken as the largest algebraically
S_2	The other principal stress
S_x, S_y	Normal components of stress in X or Y direction, respectively
a	Amplitude of a light wave
b	Thickness, in a direction perpendicular to the plane of stress
c	Distance from neutral axis to the extreme fiber
d	Depth of a beam
dx, dy	An elemental length in the X or Y direction, respectively
l	Span of a beam
n	Fringe order
q	Intensity of a continuously distributed load applied normally to the boundary
v	Intensity of a continuously distributed load applied parallel to the boundary
v_m	The maximum shear stress obtaining in any direction
v_{xy}, v_{yx}	Shearing components of stress, on the plane on which S_x or S_y, respectively, are acting
w	Width
x_1	$x_1=2x/l$
y_1	$y_1=2y/d$

*MACHINE DESIGN, Dec. 1939, page 40.

How To Utilize Rubber Under C

By Roy Brown

Firestone Tire & Rubber Co.

BECAUSE of their ability to deform when loaded and return substantially to their original dimensions when the load is removed, rubber compounds are being increasingly utilized in machines to minimize noise and vibration effectively. Therefore, data concerning deformation of rubber under typical service-loading conditions is essential before a logical design can be initiated. Since load deformation properties are not linear and are different for various compounds, this can best be expressed graphically.

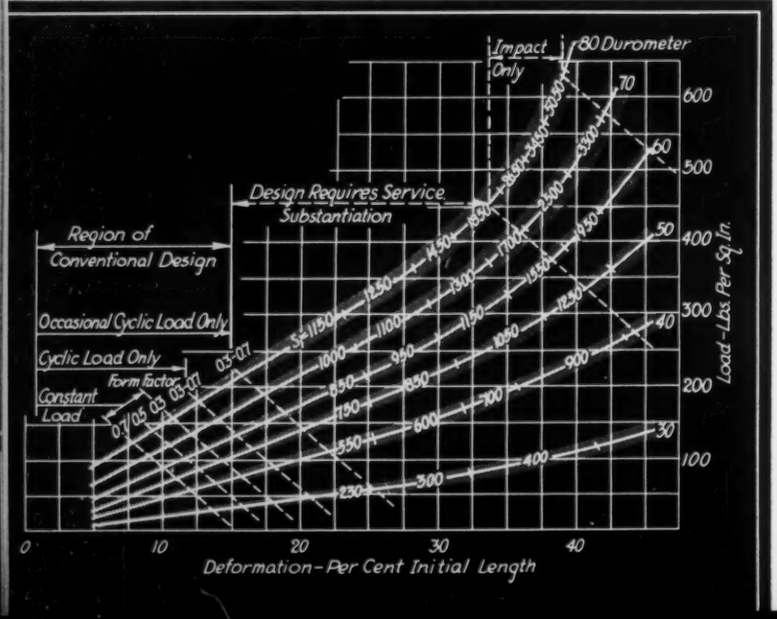
Study of methods of measuring load deformation indicates rates of load application and removal have been generally used which are much slower than those occurring on actual rubber parts in machines. Since the deflection of rubber is affected by time of load application, it is important if the load deformation data is to be used, to predetermine service performance so that the time of loading approximates the short intervals that are encountered in actual service. Tests at speeds of load application from 6 to 600 inches per minute, indicate that the nominal value of 60 inches per minute simulates actual conditions with sufficient accuracy for practical design data.

In practice, variation in conditions of operation and necessary commercial tolerances, result in appreciable spread of load deformation properties, hence accuracy in measuring this property of ± 5 per cent (shaded areas *Figs.* 1 and 2) meets present day requirements.

The designer can best visualize the performance of rubber when loaded by first considering it as a non-

From a paper presented at the Summer meeting, SAE.

Fig. 1—Load deformation for one cubic inch sample of rubber with unlubricated contact with metal. Shaded areas predict load deformation within plus or minus five per cent. Form factor is ratio of loaded surfaces to total surface. Loading rate is sixty inches per minute



compressible fluid which flows from a region of higher pressure to any available region of lower pressure. Such flow is resisted by stresses within the rubber and by adhesion to the surfaces in contact with the mounting until equilibrium occurs. It is, therefore, necessary to consider the area and type of contact with the mounting to insure accurate load deformation measurements.

Two types of mounting are of immediate interest to the designer: (1) Mechanical unlubricated contact of rubber with metal, and (2) rubber vulcanized to the metal mountings. Load deformation for 1 cubic inch samples of each type mounting for typical rubber compounds using the described sample and rate of load application, are shown in *Figs.* 1 and 2, respectively. Data for intermediate designs may be

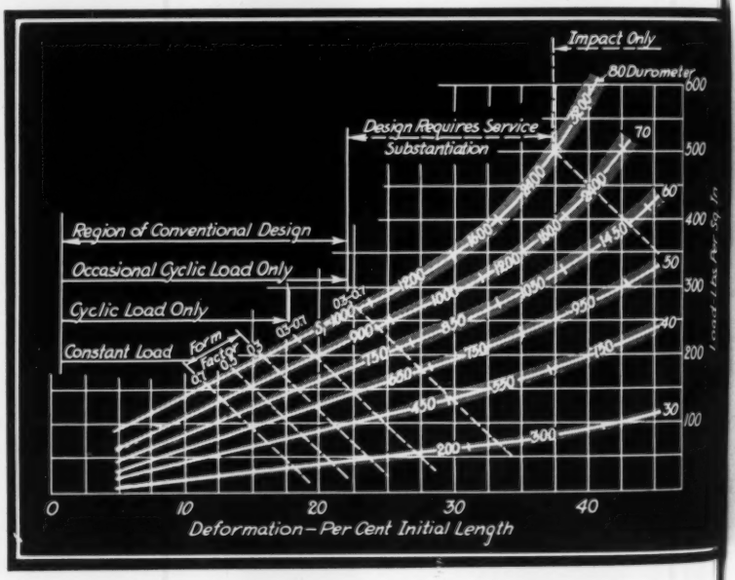


Fig. 2—Load deformation for one cubic inch sample of rubber vulcanized to metal. Other conditions are the same as in Fig. 1. Intermediate design data may be found

approximated by using proportional values from these.

STIFFNESS: In a metallic spring, stiffness has long been expressed as "Rate," i.e., the number of pounds required to deflect the spring one inch. With rubber the load required for unit deflection changes with different loads. Attempts have been made to establish a formula for such change, but all are involved and at best are only approximate. For the engineer's ready reference the property stiffness has been plotted in *Figs.* 1 and 2 so that specific values can be readily determined for the particular load or deflection being considered.

To approximate the natural frequency of a mass supported on a rubber spring, it is necessary to use the stiffness factor for the specific static load in the fundamental pendulum formula (appended list, sec-

Compression

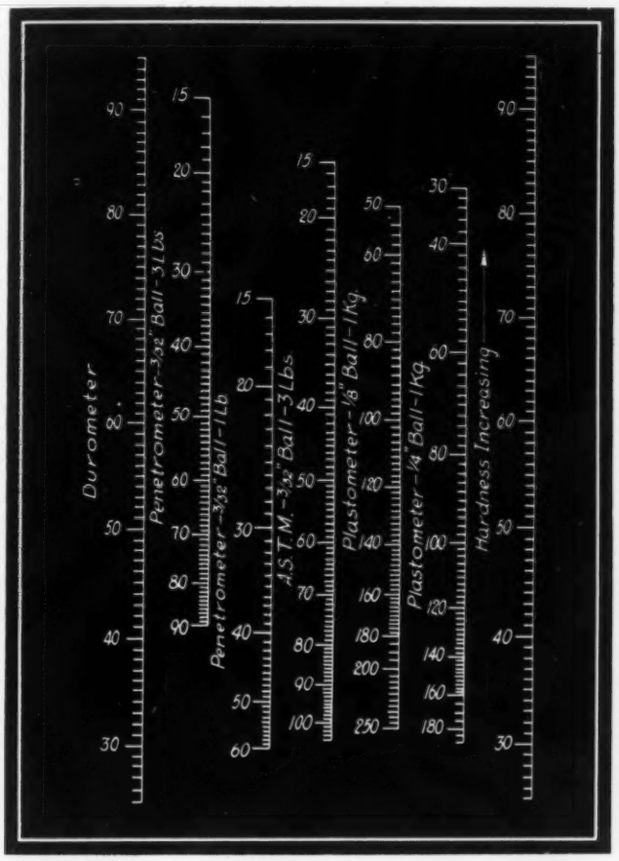


Fig. 3—Table for converting to durometer values measurements made with other instruments. Penetrometer measures penetration in one thousandth-inch; plastometer measures penetration in one hundredth-inch

tion IV) instead of total deflection under static load as is commonly done for metallic springs. Such information is very important in the logical design of rubber for supporting a mass and thereafter isolating the supporting structure from vibrations which cause only small additional deflection such as motor mountings. Knowledge of natural frequencies is also essential to enable prevention of resonance with other associated elastic systems.

HARDNESS: With metals, hardness is usually expressed as a function of, or the result of, load application of a magnitude sufficient to cause permanent distortion or fracture of the surface being tested. Such methods are not applicable to rubber on account of the large deformation required to cause any permanent change in the tested surface and the sudden and erratic surface failure which results with break down loading. As a matter of fact, hardness measurement is complex and subject to serious error from causes too numerous to discuss in this article.

Much study has resulted in numerous individual

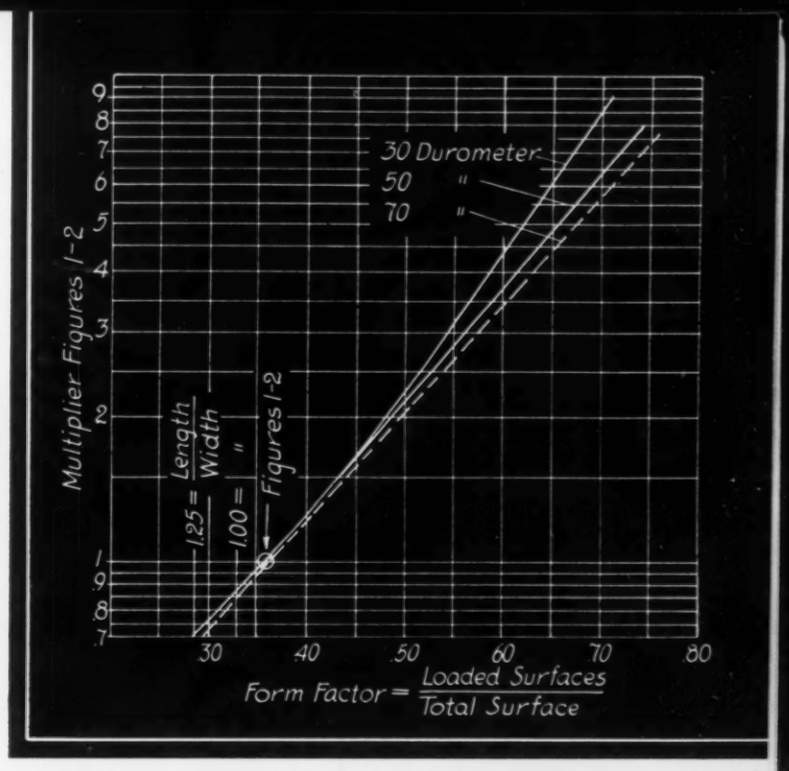


Fig. 4—Form factor data for cylindrical samples, the multiplier applying to stiffness as indicated in Figs. 1 and 2. Values shown are average for loads up to one hundred pounds per square inch

methods of accomplishing a measurable property for rubber compounds, akin to hardness in metals, which could be used in a similar manner to designate a property indicative of load deformation performance. A number of instruments have been developed to measure "hardness" of which the plastometer, the durometer, and the penotrometer have been generally used. Of these the durometer has been and is being generally used despite its serious limitations and low accuracy.

Standard methods of hardness measurement specify the conditions of use, size, and shape of the point, load on the point, and value of indentation of the point into the rubber surface being tested. These, if followed, will provide comparable results. Unfortunately the vagaries of the durometer exclude it from any serious inter-comparison. It is suggested that measurements be made with other instruments and the indications be converted if necessary to durometer, using values given in *Fig.* 3.

Mounting Condition Important

FORM FACTOR: The conception of rubber compounds as a noncompressible fluid, tending to flow from a region of higher pressure to any available region of lower pressure until forces are equalized by elastic stresses set up in the material, is helpful in visualizing the effect upon load deformation properties of the mount to which the rubber is attached. Area of the rubber part in contact with the mounting exerts a restraining force in addition to elastic forces set up in the rubber. This mounting condition must be considered if load deformation properties are to be predetermined with sufficient accuracy for design purposes.

Mounting conditions have been recognized and load

deformation curves are shown in the literature for different areas of loaded surfaces on the mountings. The introduction of a single property — Stiffness — which is a valid index of the load deformation relationship, enables the effect of the mounting to be expressed as a multiplier applicable to the stiffness values shown in *Figs.* 1 and 2. While such simple conception provides data adequate for design purposes, it should not be used for extremely complicated shapes or box-like structures such as certain type motor mountings where the actual mounting, as well as total effective areas, are indeterminate.

The marvelous flexibility of rubber compounds enables attachment to the mounting in nearly every conceivable manner. Therefore, general expressions can only approximate the performance of the simpler types of mountings. Such data supplies a base, correction factor for which can be experimentally determined for the more complicated mounting types.

Here again, the conception of rubber compounds as elastic noncompressible fluids is helpful as it enables flow (elastic deformation) to be predetermined on the basis of the ratio of the loaded surfaces (restricted

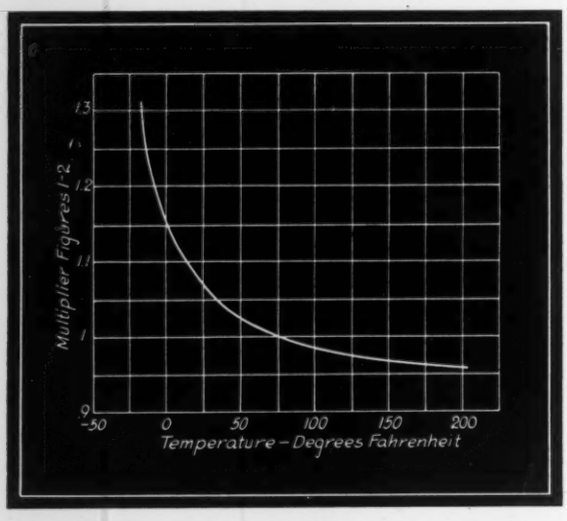


Fig. 5—A convenient means of correcting load deformation data to the particular temperature desired is provided by the multipliers in this graph, when applied to the stiffness values in Figs. 1 and 2

flow) to the total surface. Such conception would not be mathematically correct for all conceivable dimensions. However, the commercial rubber vulcanization process limits thicknesses to 1 or 2 inches. Within these dimensions, form factors based on ratio of areas provide simple usable information for the designer.

In case the rubber compound is confined in the mounting, the rubber being non-compressible must be considered for design purposes as non-existent, i.e., the effective mounting surfaces are across the lips of the cup and not at the bottom. Perforations, corrugations, and holes on the surface or within the central portions, are to be considered as freely unloaded surfaces and are to be included in the total area.

Form factor data of the described type has been prepared for cylindrical samples and is shown in

Formulas for Dynamic Properties

I. Deformation—Amplitude—Deflection:

(a) $A = \frac{W}{S}$

(b) $A = \left(\frac{188}{F}\right)^2$

(c) $\frac{A_1}{A_3} = \frac{1}{\sqrt{\left[1-\left(\frac{F_1}{F}\right)^2\right]^2 + \left(2D\frac{F_1}{F}\right)^2}}$

When $D = O$

(d) $\frac{A_1}{A_3} = \frac{S}{.0000284\,F_1^2 W - S}$

II. Load:

(a) $W = SA$

(b) $W = \frac{35300}{F^2}$

III. Stiffness:

(a) $S = \frac{W}{A}$

(b) $S = \frac{F^2 W}{35300}$

(c) $S = \frac{S_1 \times Loaded\ Area}{Effective\ Length}$

IV. Frequency:

(a) $F = 188\sqrt{\frac{S}{W}}$

(b) $F = \frac{188}{\sqrt{A}}$

V. Damping—Hysteresis effect:

When amplitude of impressed frequency is constant and $F = F_1$

$2D = \frac{1}{A_2/A_3}$

VI. Transmission of vibration:

(a) $T = \sqrt{\frac{1+\left(2D\frac{F_1}{F}\right)^2}{\left(1-\frac{F_1^2}{F^2}\right)^2 + \left(2D\frac{F_1}{F}\right)^2}}$

When $D = O$

(b) $T = \frac{1}{\left(\frac{F_1}{F}\right)^2 - 1}$ *above resonance*

(c) $T = \frac{1}{1-\left(\frac{F_1}{F}\right)^2}$ *below resonance*

VII. For determining effect of dynamic oscillators:

$$\frac{A_1}{A_4} = \frac{1}{\sqrt{\left(1-\frac{F_1^2}{F^2}\right)^2 + \left(2D\frac{F_1}{F}\right)^2}}$$

VIII. For harmonic motion:

$$Ac^{max.} = \frac{A_1(F_1)^2}{35273}$$

IX. For sound vibrations:

(a) $V = 1179\sqrt{\frac{S_1}{W_1}}$

Fig. 4. The multiplier in *Fig.* 4 applies to stiffness as indicated in *Figs.* 1 and 2. Values shown are average for loads to 100 pounds per square inch. Larger loads could be more accurately represented with somewhat higher values. Additional curves for the larger unit loads can be added when justified by improvement in other conditions now limiting application of design data.

TEMPERATURE FACTOR: Present-day applications of rubber function at temperatures varying from minus 10 to plus 200 degrees Fahr. The designer should therefore have information available concerning the effect of temperature on the load deformation properties of rubber compounds, but unfortunately this information is not in convenient form. One means of correcting load deformation data to the particular temperature desired is provided by the stiffness property, however. Multipliers for this purpose are shown in *Fig.* 5 and may be used for correcting to the desired temperature load deformation graphs in *Figs.* 1 and 2.

PERMANENT SET: The design engineer is, of course, interested in the way the rubber part performs in the hands of the user. Length of a rubber part changes slightly on the first several successive loadings occurring after vulcanization. It also changes sensibly and permanently on continued application of loads.

A standard method of measuring the permanent deformation or set, known as "Compression Set of Vulcanized Rubber," is now in general use in the rubber testing laboratory. This method provides comparable data secured under accelerated temperatures (158 degrees Fahr.) and loads (400 pounds) on a cylindrical sample, 1 inch in area on the loaded faces, and ½-inch thick. Correlation of permanent set data secured by the standard method, with actual service conditions for each part, must be made before final conclusions can be derived.

Permanent set (per cent of initial length) determined by the standard method for highest grade rubber compounds having low hysteresis and having hardnesses of from 40 to 70 durometer, will vary from 15 to 10 per cent, respectively.

DYNAMIC PROPERTIES: The dynamic performance of rubber is exceedingly complex, being complicated further by the comparatively large difference in performance of different compounds under dynamic conditions. In addition, not too much is known about the actual dynamic conditions occurring at the point of application, so that it is impossible at this time to provide the designer with a concise and complete dynamic properties picture. But in list, page 52, are presented the more important formulae for application of rubber under various conditions. Some of these conditions are discussed further in the following.

HYSTERESIS: Dynamic tests are necessary to evaluate the hysteresis effect in rubber compounds. Load deformation effects of this property need not be directly considered by the designer as they are included in the load deformation curves. It is to be consid-

(*Continued on Page* 96)

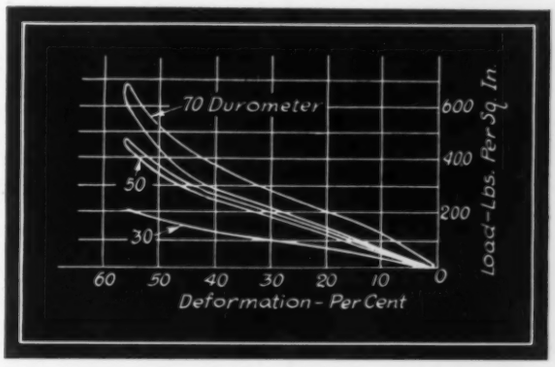
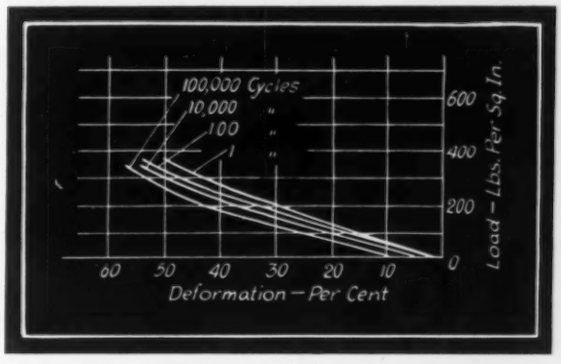


Fig. 6—Typical examples of the hysteresis effect under fifty per cent deformation and sixty inches per minute rate of load application. Fig. 7—Below—Creep resulting from successive load application for the vulcanized sample used for values in Fig. 3



Nomenclature

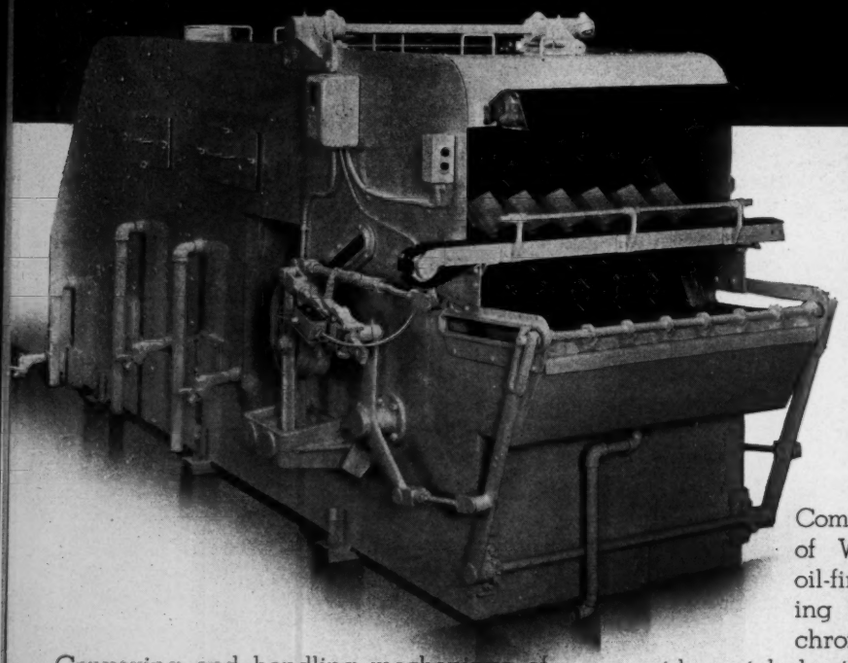
A = Deformation (ins.) as loaded
A_1 = Amplitude (ins.) of harmonic displacement of load at frequency specified
A_2 = Amplitude (ins.) of harmonic displacement of load at natural frequency
A_3 = Amplitude (ins.) of impressed harmonic vibration
A_4 = Equilibrium deflection which would be caused by the maximum of the impressed sine force if it were acting statically
W = Load (lbs.) to cause deformation A
W_1 = Specific weight (lbs./cu. in.)
S = Stiffness (lbs. load/in. deformation)
S_1 = Unit stiffness (lbs. load/in. deformation/in. area/in. length)
F = Natural frequency (cycles/min. undamped sine) of loaded elastic system; or
F = Frequency occurring near maximum deformation caused by impressed vibration, i. e., frequency at resonance
F_1 = Frequency (cycles/min.) of impressed harmonic vibration
D = Damping ratio, a numerical value representing energy tending to restrain motion; or

$$D = \frac{\text{Actual damping coefficient } C}{\text{Critical damping coefficient } Cc}$$

D_1 = Hysteresis ratio $= \dfrac{\text{Energy restored}}{\text{Energy absorbed}}$

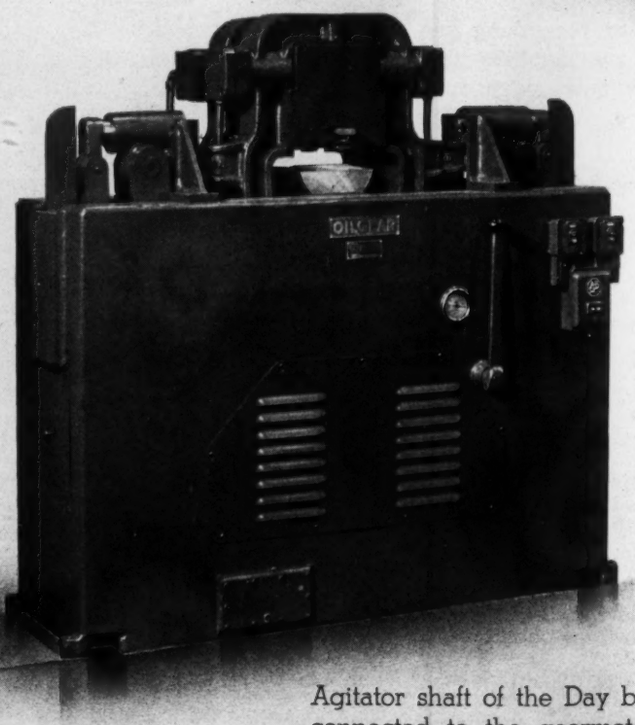
$T = \dfrac{\text{Transmitted force}}{\text{Impressed force}}$ or,

T = Ratio of force transmitted to the fixed mounting of the elastic element to that impressed upon the load; or
T = Ratio of force transmitted to the load to that impressed upon the mounting
Ac = Acceleration, maximum (gravity units—32.2 ft./sec./sec.)
V = Velocity (in./min.)



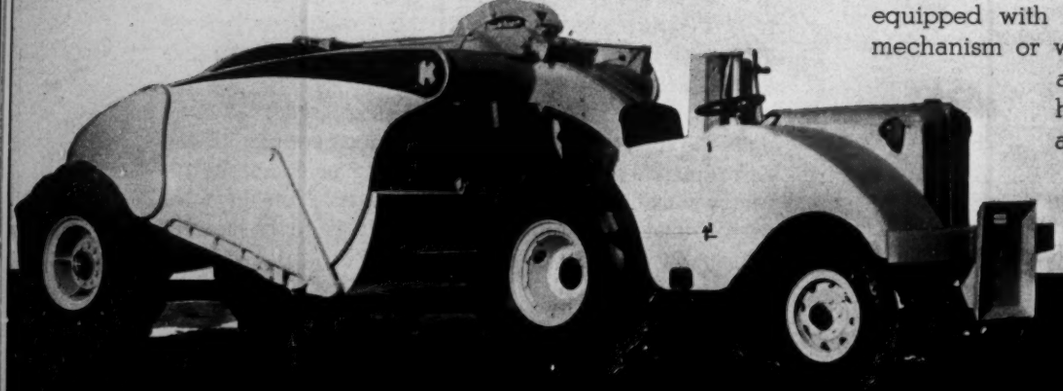
Conveying and handling mechanisms of the Wright-McKinley bottle washer (above) are driven by a single-end motor with a variable speed pulley, connected by V-belt to a speed reducer. Further speed reduction is provided by heavy gears on the mainshaft. Tandem pumps driven by a larger motor operate both light alkali and fresh water tanks. Three automatic safety devices give operator protection

Combustion chamber of Westinghouse Oak oil-fired air conditioning unit (right) is chromium steel to provide quick heating, and an anti-pulsator is located under the chamber to absorb pulsation noise. Extra heating surface is provided around the sides and bottom of the section enclosing the chamber. An oversize blower is utilized, driven by thermoguard motor



Hydraulic clamps in the stationary and twisting supports of the Oilgear propeller twisting machine (right) are controlled simply by pushbutton. The hydraulic pump has simplified piping and oil circuit, requiring no external control or relief valves, and is arranged for direct drive. Welded steel frame supports the pump, motor, cylinders, equalizers, stationary clamp support and other units

Three-point suspension of the free oscillating, spring-mounted steering axle of the Koehring tractor wheeler (below) eliminates bending strains when traveling over rough surface. Spring-mounted push connection at rear of tractor dissipates shocks and permits short turning radius of more than 90 degrees. Constant mesh transmission provides smooth operation



Design
IN NEW

(For new machi ing

THIS MONTH'S C R.
neering room at Prog e
on East Outer drive, D , d
1941 automobile bo re
machines are closely ed,
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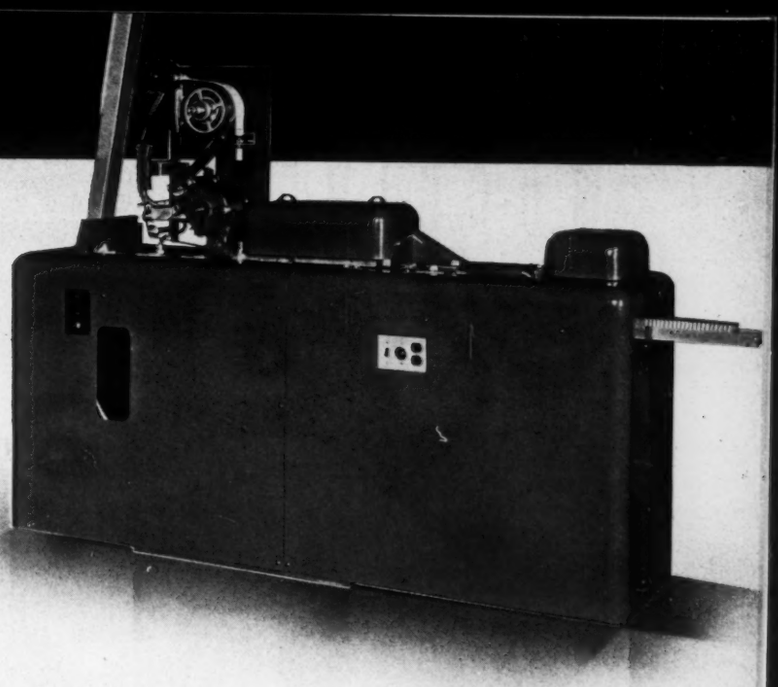
advance of announce he

Agitator shaft of the Day bakery mixer (right) is connected to the gearmotor by a roller chain drive with an adjustable idler. All motors and control equipment are in base. The mixer comes equipped with an easily operated hand tilting mechanism or with a combination of both hand and power dump, using a one-horsepower brake motor. Segment and worm for tilting tank are enclosed in the frame

Direct-connected to its quarter-horsepower motor, the DeVilbiss light air compressor (above) has more power than former units utilizing larger motors. Generous provision of fins adequately cools compressor chamber and provides a horizontal design motif. Motor is left partly exposed to cut down weight and size. Compressor, motor, air strainer, crankcase and pulsation chamber form an integral unit with two-color baked crystalline finish

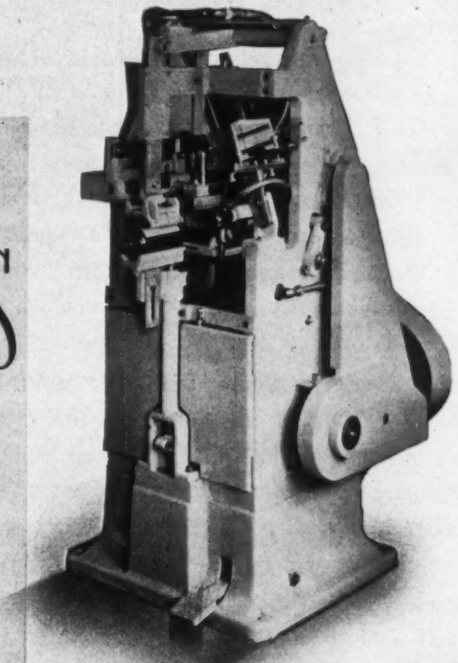


Continuously moving conveyors permit straight line wrapping operation of the Redington cellophane wrapper (above) at speeds as high as two hundred and fifty packages per minute. Driven by a gear-motor, the machine has a cast iron frame. Magazine feed or belt intake can be supplied. Counter with reset knob is standard equipment

...ign Features ...V MACHINES

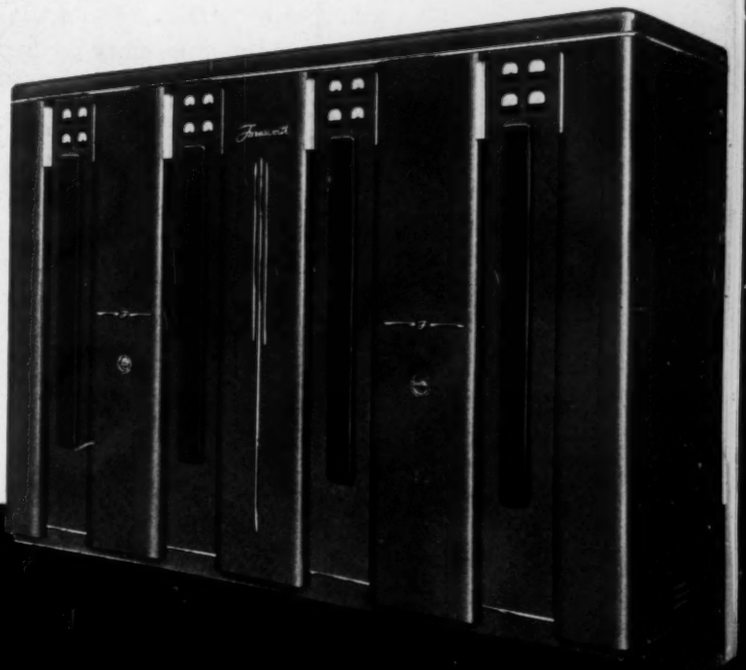
...w machi...ing see page 106)

...I'S C...ER. In this special engi... Progr...e Welder Co.'s new plant ...rive, D..., designs of stampings for ...le bo... refrigerators and other ...osely ...ed. The room is wired for Des...are completed months in ...ounce... held in complete secrecy



Vacuum pump and actuating mechanism of the World labeler (left) are driven by a single half-horsepower motor, while a variable speed transmission synchronizes the speed of the machine to the skill of the operator in feeding containers into and removing them from the labeler. A unique locking arrangement for the gum box cradle keeps the transfer pad from contacting the gum rolls unless there is a label ready for application of gum

Component parts of the Farnsworth 1000-watt television transmitter (right) are supported on and within four U-shaped steel columns. Since each column is mounted on its own base and assembled as a unit, four assembly groups may work independently. The vertical arrangement promotes ventilation and facilitates disassembly for shipment. Doors extending across entire back of cabinet give complete accessibility



MACHINE DESIGN

Editorial

It's up to the Designer!

IN HIS address immediately following Italy's entry into the war President Roosevelt spoke feelingly about, among other things, the machine and its place in the current conflict. For once he credited the machine with playing a highly important part in the progress of civilization—if used to best purpose rather than abused. He inferred that the machine—in the hands of the unscrupulous—is the primary factor in destruction of life and property, but on the other hand could well be the only means of upholding all the principles that democracy holds dear. How well that has been proved time and again during the past few months by the cries of the hard-pressed Allies "More planes, more tanks, more guns"!

Rightly or wrongly the engineer takes the limelight in this picture—the metallurgist, the engineer in charge of production and above all the designer. In the preparedness program now getting under way, his is the initial responsibility for laying out designs of war equipment that not only will surpass anything used in the war thus far, but also lend itself to mass production in the shortest possible time.

As pointed out recently by Charles F. Kettering, reports of producing, for instance, 1000 planes a day can well tend to create a false impression in the minds of the public. The man in the street fails to realize how much time is necessary before quantity production can be reached. As an example it is said that more than two years' time was needed between the conception of the Ford Model "A" and actual production of the first of these cars.

That was peace-time development and production rather than war-time program. Now we are faced by a much more grim reality. Whether used to help prevent war reaching us, actually to defend the country or to entitle us to a hearing at any future peace settlement, we need war machines—and equipment for producing them—of the first order. The designer and those associated with him carry a heavier responsibility now than at any period in the country's history. Let us not fail—we have no time to lose!

Professional Viewpoints

" . . . . worth designer's study"

To the Editor:

The series of articles on photoelastic analysis, by R. E. Orton, started last March, is certainly worth a designer's study.

Mr. Orton is right when he says that most of the literature on the subject has been written from the standpoint of a physicist. The separation of the *P* and *Q* stresses, and the complete determination of stress distribution within a model are interesting problems, the solution to which should not be omitted from a study of stress analysis. However, no commercial designer need feel especially handicapped by a lack of such knowledge. The section in the series entitled, "Failure Begins at Boundary," explains this. True, a certain amount of theoretical background in elementary elasticity and light is essential but no more than is within the grasp of any engineer.

Mr. Orton's paper is all the more convincing because his illustrations are drawn from actual cases he has met and solved photoelastically.

—R. R. SLAYMAKER
Case School of Applied Science

" . . . . deserves careful review"

To the Editor:

The article in MACHINE DESIGN for June 1940 entitled "Basic Principles Applied to Machine Control," by Mr. O. G. Rutemiller, is unusually informative and interesting and with such wide general application that it deserves careful review. For this reason, I suggest the following restatement of the discussion for the "tapping machine circuit" of *Fig.* 20, as given on page 54, with a view toward expanding the explanation so that other engineers, like myself, who are not experts in this field can understand the circuit more completely.

> Known as the "tapping machine circuit," *Fig.* 20 provides automatic reversing which stops after one cycle. It is used on reversing tapping machine drives and similar applications. When the forward button is depressed the forward contactor *F* is energized through the closed limit switch *FLF* and the normally closed auxiliary contact *R* is held closed after the forward button is released. As the forward part of the cycle progresses to end of forward stroke, the limit switch *FLF* then opens as by a cam. Its normally closed contacts de-energize the *F* contactor and its normally open contact energizes the reverse contactor *R* through the released forward button which is in position shown, and through the normally closed contact of the de-energized *F* contactor, thereby plugging the motor. When the reverse limit switch *FLR* again opens, the motor is stopped. This limit switch closes shortly after start of forward stroke and opens to the position shown at end of reverse stroke.

R. E. BRUCKNER
Kimball Glass Company

" . . . . useful as comparative index"

To the Editor:

In my opinion the plastics comparator chart published in the May issue of MACHINE DESIGN should serve as an excellent guide for the engineer in ascertaining those materials which will prove most feasible for a given design in molded plastics. As one becomes familiar with this chart, it will be found that usually more than one material suggests itself for a given task, and the designer may have to forego some desirable property of one material for the really outstanding requirement of the design. It may be further observed that cost and the rate of production of parts will have a decided influence on the selection of material. However, the chart is very useful as a comparative index, though in cases of doubt or where more specific information is required a plastics company or plastics engineer should be consulted.

A slight correction may be found necessary for the column comparing cold flow properties, as my tests have shown that polystyrene and some of the hot molded phenolics do not differ very greatly in cold flow rate.

—J. DELMONTE, Technical Director
Plastics Industries Technical Institute

" . . . . need most efficient machines"

To the Editor:

In your editorial, *Planning for Eventualities,* the executive you quote hits the nail on the head when he says his company will always be so far ahead that his competitors will be using obsolete methods.

There is one thing which we must bear in mind regarding the present war. It is a machine war. For that reason, if for no other, it is going to make more people in more nations appreciate the need of using more machines—the most efficient machines—and using them in the most effective manner.

—J. E. BULLARD
Central Valley, N. Y.

Applications

OF ENGINEERING PARTS AND MATERIALS

Gear Unit Has Dampening Effect

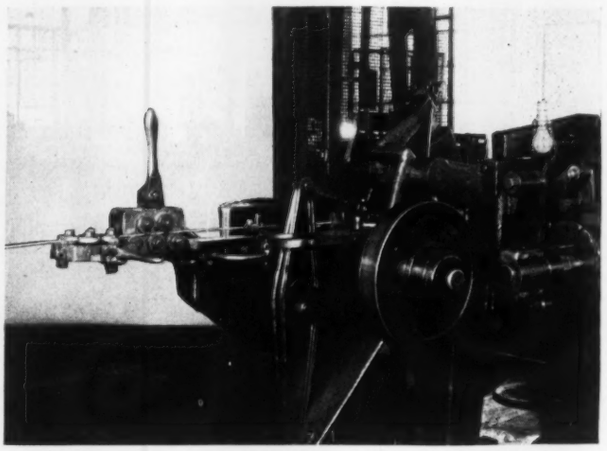
SOUND and vibration dampening effects of the gearcase housings contribute to the smooth, quiet operation of the two-pinion reduction units for the five Maritime Commission C-1 ships now being built. Housings, covers and bearings of the units are Farrel Meehanite in which the design has been worked out to provide maximum stiffness and rigidity.

These features are important in keeping the pinions and gears in strict alignment which results in longer life for the revolving elements and less trouble with bearings and accessories. Castings are stress relieved in an oven to assure that no change in shape will take place after machining nor after installation in the vessels.

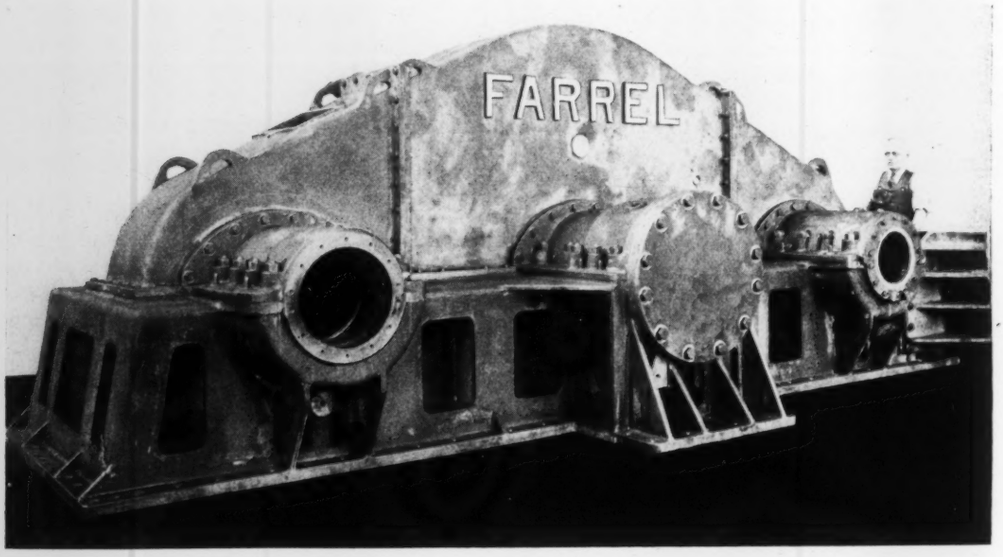
A process-inoculated iron, Meehanite contains a high percentage of heavy melting steel scrap and can be processed to meet specific requirements. The housings of the propulsion gear units have a minimum tensile strength of 40,000 pounds per square inch. Some of the smaller castings are also the same material while the bearing caps have 50,000 pounds per square inch or more tensile strength.

Alloy Rolls Resist Wear

OUTWEARING steel rolls on a straightening machine for steel spring wire, Haynes Stellite alloy rolls have operated satisfactorily for ten years on a machine at the National Telephone Supply company where formerly rolls for this service had a life of



Alloy rolls shown at left on wire straightening machine would outwear thirty sets of steel rolls



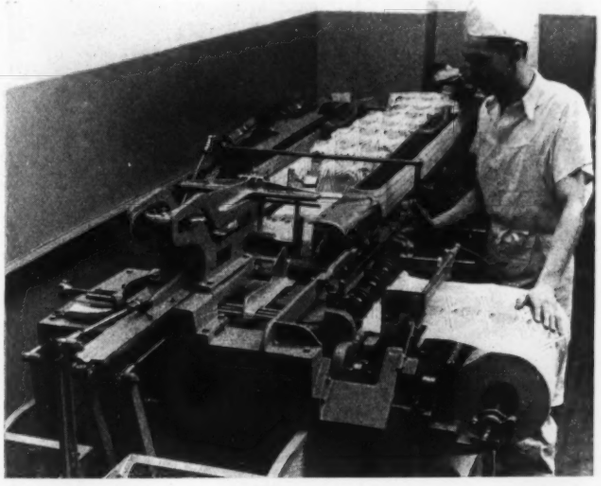
For Maritime Commission C-1 ships, this gearcase is designed for stiffness and rigidity

about four months. The wire straightened by these rolls is .223 inch in diameter with a flat on each side and is manufactured into loops or hangers for telephone cables.

Even after five years of service, these red-hard alloy rolls showed only .003 inch wear and replacement was not necessary until recently with a service of almost ten years.

Phototube Controls Wrapping

INDIVIDUAL wrappers are cut to equal lengths and the printed design is always in the same location in this Hayssen bread wrapping machine with electronic control. A phototube scans the printed design and operates the cutter at the precise instant providing more neatly wrapped packages. A Westinghouse control, it consists essentially of a phototube amplifier circuit and a thyratron control circuit. The former circuit amplifies the voltage impulses caused by rapid changes in the phototube illumination and the latter operates the relay that controls the driving motor for adjusting the feed and cutting mechanism.



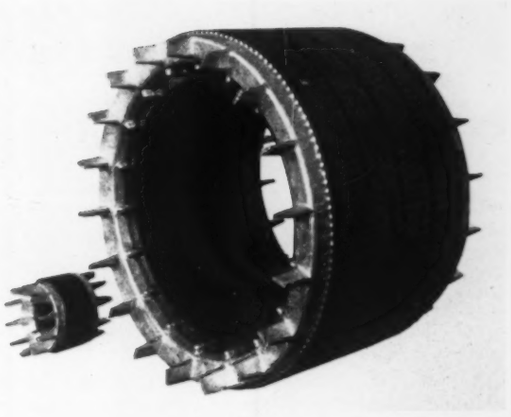
Electronic register on wrapping machine assures neat packaging. Phototube is housed over edge of paper

Die Casting Applied to Large Rotors

MOTORS as large as 250 horsepower now utilize rotors of die-cast aluminum. Increased casting pressures, preheating core to 600 degrees Fahr. before casting and increasing speed of casting press have been largely responsible for this development.

Previously the wide difference between the coefficients of expansion for aluminum and steel was thought to preclude application of this process to large size rotors. It was believed that aluminum end rings and steel core in large sizes would develop stresses on cooling which would snap off or shear the two dissimilar metals. Cycles of heating and cooling in service might cause failure from the same cause.

These problems are solved by the new process developed by the Reliance Electric & Engineering Co., making the advantages of die-cast rotors applicable to heavy-duty motors. These advantages include improvement of fatigue properties against vibration, better balance, increased ventilation and more uniform electrical characteristics.

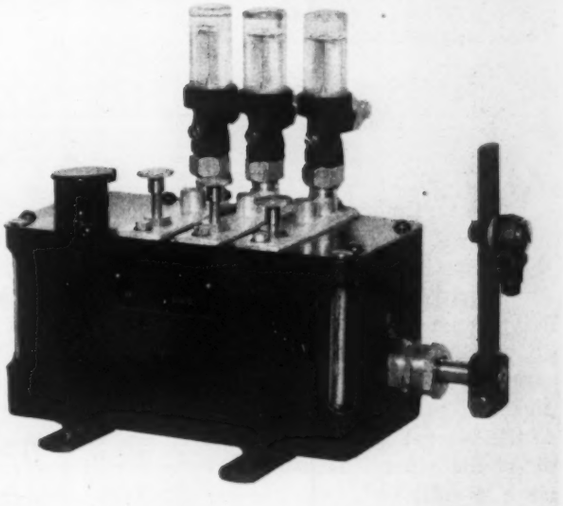


Improved process makes possible pressure cast aluminum end rings on steel core for large rotors. Rotor for 1-horsepower motor indicates size

Increased Visibility with Plastic

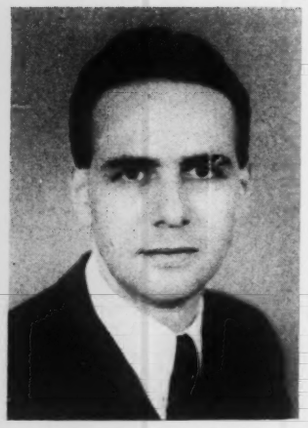
SIGHT gages on the McCord force feed lubricator illustrated are Plexiglas, a transparent plastic strong enough to withstand the operating pressure of 2000 pounds per square inch, accidental blows and other service conditions to which the lubricator might be subjected.

This lubricator delivers definite changes of oil at regular intervals and it is often necessary to watch the oil flow. The sights are machined and threaded in a lathe from solid rod and are actually clearer than glass, permitting close observation from any angle wherever the lubricator is mounted.



Machined from solid transparent plastic rod, sight gages withstand pressure and accidental blows

Men of Machines



JOHN DELMONTE

RECOGNIZED as an authority on the application of plastics to design problems, and one who has gained much of his knowledge through first-hand experimental work and actual application, John Delmonte has accepted the position of technical director at Plastic Industries Technical institute, Los Angeles. He had been assistant to the chief engineer of Chicago Flexible Shaft Co. for some time, and recently conducted a course on plastics at Armour institute graduate school, Chicago. During this time he also wrote *Plastics in Engineering,* one of MACHINE DESIGN'S new books, which is prepared directly for the designer on plastics and their application. He has also contributed various papers on plastics, both to societies and plastic journals. Prior to his connection with Chicago Flexible company, Mr. Delmonte was employed by Firestone Tire & Rubber Co. research laboratories, which he joined upon resigning from the Physical Testing Laboratory at the Naval Aircraft Factory.

W. A. PARRISH

RECENTLY appointed assistant chief engineer of Cummins Engine Co., Columbus, Ind., Walter A. Parrish has an engineering background which will prove invaluable to him in his new connection. Previously he was engine designer of Caterpillar Tractor Co.

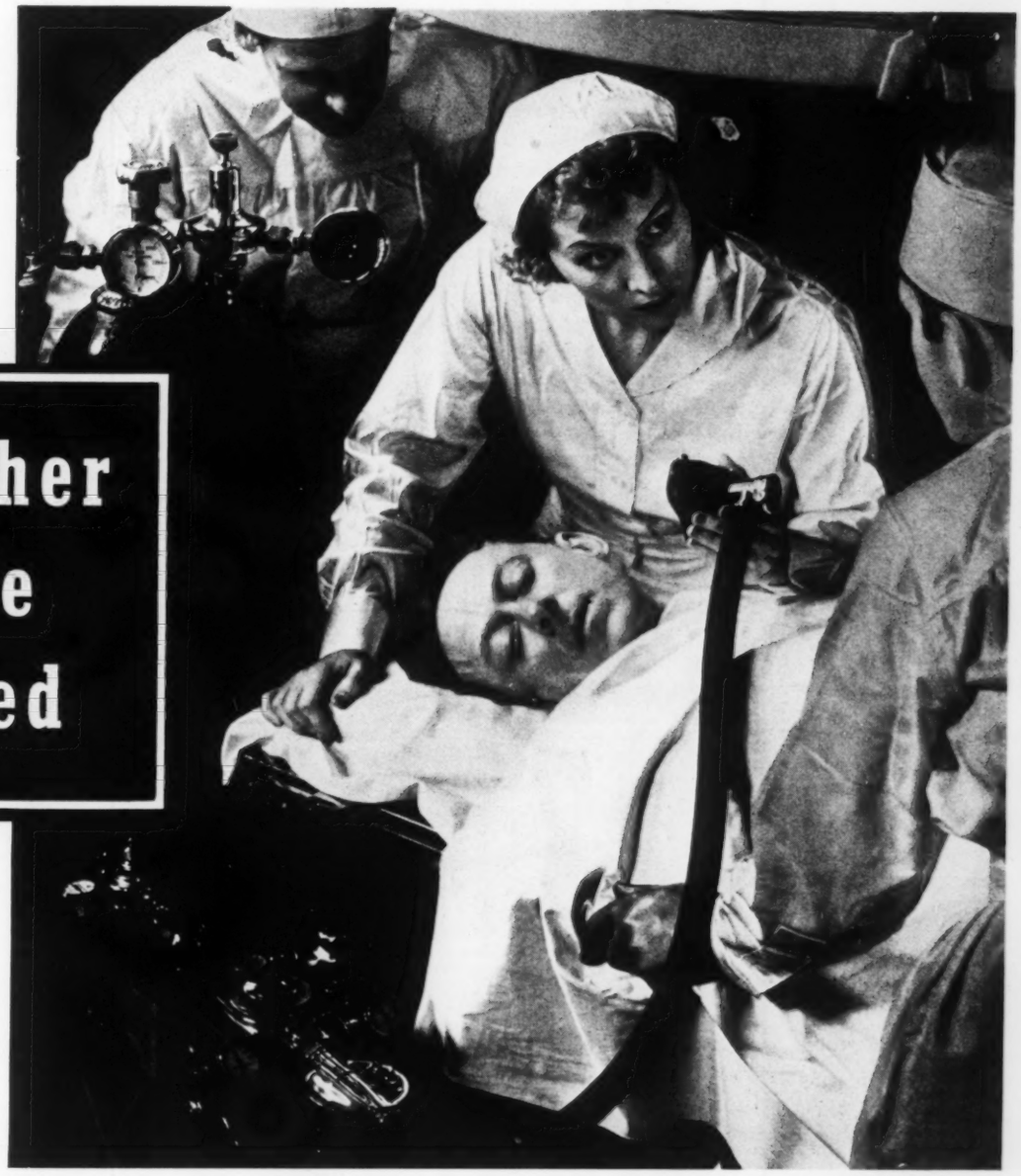
After graduating from Detroit Technical institute, he was connected with the engineering departments of several companies. From 1919 to 1922 he was chief engineer with the Akron Motor Truck company, where he assisted in the early development of high-speed pneumatic tired trucks. Joining Hercules Motors Corp. as sales engineer, he became engine designer a year later. In the same capacity he became connected with White Motor Co., where he remained until his appointment as assistant chief engineer of The Buda Co. Later he was named chief engineer of the Buda Co. in charge of design, development and laboratory tests. After six years with that company he joined the Caterpillar organization as engine designer.

F. M. FEIKER

A FORMER director of the United States Bureau of Foreign and Domestic Commerce, and executive secretary of the American Engineering Council, Frederick M. Feiker has been named dean of the School of Engineering, George Washington university.

A native of Massachusetts, Dean Feiker graduated from Worcester Polytechnic institute in 1904, and two years later joined General Electric Co. as technical journalist. After some editorial work, he was appointed assistant secretary of commerce. From 1923 to 1931 he served as vice president of the Society for Electrical Development, later returning again to the federal government service. In 1933 Dean Feiker was chosen to direct the educational survey of the Textile Foundation, and has continued since as educational consultant. He was elected executive secretary of the American Engineering Council a year later. Having experience as an engineer, publisher and executive, he joined the faculty of the School of Engi-

Another Life Saved



Again the surgeon's touch—gentle, firm and sure—has snatched a human life from the grave. Every day in thousands of machine shops the surgeon-like touch of TIMKEN Bearings on machine tool spindles is saving countless parts from a similar fate—the scrap pile. With every defective part condemned by spindle "chatter" to a premature end goes a part of your profit.

Timken Bearing Equipped spindles are life savers for every machine shop operator who uses them. Make sure your new machines have the "surgeon's touch" and reduce the death-rate in your daily production.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Manufacturers of TIMKEN Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; TIMKEN Alloy Steels and Carbon and Alloy Seamless Tubing; and TIMKEN Rock Bits.

TIMKEN
TAPERED ROLLER BEARINGS

neering of the George Washington university last fall as professorial lecturer in management problems. Previously he had taught in summer sessions. Dean Feiker is a member of the American Institute of Electrical Engineers, The American Society of Mechanical Engineers, American Association for the Advancement of Science (secretary of the engineering section), and the Society for the Promotion of Engineering Education.

♦

OSCAR E. HARDER, assistant director of the Battelle Memorial institute, has been nominated for president of the American Society for Metals. BRADLEY STOUGHTON is the nominee for vice president. He is consulting engineer at Lehigh university. WILLIAM H. EISENMAN has been named to succeed himself as secretary for the society.

♦

JOHN G. BERGDOLL has been appointed chief engineer of the York Ice Machinery Corp. Since joining the company in 1914 as machinist's apprentice, Mr. Bergdoll has occupied the positions of draftsman, equipment development engineer, product engineer, assistant chief engineer, and now chief engineer.

♦

PAUL E. HOVGARD, veteran test pilot and engineer, has become chief research engineer of The Glenn L. Martin Co., succeeding JOHN B. WHEATLEY, who now assumes responsibility for the company's development work.

♦

STANLEY M. MERCIER has been appointed to the position of chief engineer, conveyor division of The Jeffrey Mfg. Co., Columbus, O.

♦

DAVID L. MEKEEL, who has been associated with engineering and development for many years, has retired from active duty with Jones & Laughlin Steel Corp., to become general steel mill consultant.

♦

WALTER S. TOWER was unanimously elected president, chief executive officer and a director of the American Iron and Steel institute at a general meeting held by the institute recently. Mr. Tower was formerly executive secretary.

♦

M. W. HUBER, who has been connected with the Tuthill Pump Co., since 1933, has been named vice president in charge of engineering and production. He began with the company as engineer in charge of development, and later became general manager in charge of engineering.

♦

ERNEST LEFFERT ROBINSON, General Electric turbine engineer, has been awarded the honorary degree of Doctor of Science by his alma mater, St. Lawrence University.

♦

PAUL KLOTSCH, well-known automotive and aviation engineer, has been appointed chief engineer of the Automobile division of The Crosley Corp. One of his outstanding aviation achievements was his work in the design and development of the 175-passenger airplane projected by the General Development Co. of New York, in 1930.

♦

RAY PATTEN, head of General Electric's design staff at Bridgeport, Conn., and particularly known for ensemble styling of various electrical appliances, was granted an award for designing the company's electric range. The awards were presented by Lord & Taylor. HENRY DREYFUSS, an industrial designer, received the award for the design of a washing machine for the Apex Rotarex Corp.

♦

JOHN V. O. PALMER has been appointed vice president in charge of engineering and research of Cleveland Graphite Bronze Co., Cleveland.

♦

FRANK RISING has been named general manager of the Automotive Parts and Equipment Manufacturers Association Inc., succeeding Clarence O. Skinner.

♦

PAUL R. MATTIX has been appointed chief of the Automotive-Aeronautics Trade division, Bureau of Foreign and Domestic Commerce.

♦

HENRY LOWE BROWNBACK has been elected to the council of the (French) Society of Automotive Engineers. Mr. Brownback is a consulting engineer at Norristown, Pa.

♦

DAVID L. LINQUIST, chief engineer of Otis Elevator co., has been given the John Ericsson Medal of the American Society of Swedish Engineers of New York in recognition of his standing as a scientist, inventor and engineer.

♦

E. C. CRITTENDEN has been elected president of the United States National Committee of the International Electrotechnical commission succeeding DR. C. H. SHARP who has been named honorary president. Mr. Crittenden was formerly chief of the electrical division of the National Bureau of Standards.

♦

DANIEL COWAN JACKLING, past president of the American Institute of Mining Engineers, has received the Washington award commission in recognition of pre-eminent service in advancing human progress "by pioneering in large-scale mining . . . . "

♦

E. A. LONGENACKER, industrial engineer, has been elected president of Lauson Co., New Holstein, Wis.

♦

ARTHUR A. MAYNARD has been appointed director of engineering of General Motors of Canada Ltd., Oshawa, Ont.

MORE STRENGTH TO MEET STRESS...

50 *places in a power shovel...*

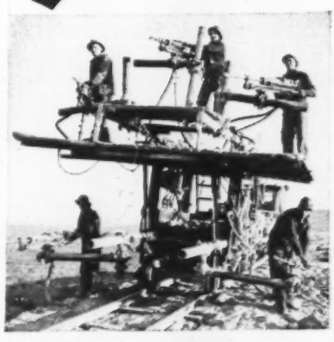
85 *places in a rock drill...*

275 *places in a milling machine*

NICKEL ALLOY STEELS

Measured by weight, nearly ⅓ of this Bay City power shovel is fabricated from long-wearing Nickel alloy steels. 50 vital parts which must withstand fatigue strains, shock stress and overloads are made of SAE 3135 oil quenched Nickel-chromium steel and other Nickel alloy steels. Frames and bases are Nickel cast steel. "Chabelco" crawler drive chains, Diamond crowd chain, Hercules gasoline and Caterpillar Diesel engines on Bay City shovels also employ high strength Nickel alloy steels for important stressed components.

More than 275 stressed parts in this dial type Cincinnati milling machine are Nickel alloy steels. Nearly 200 of these parts are made of a Nickel-chromium steel, heat treated to high strength yet readily machinable. Parts subject to wear are case-hardened.



Here are five Gardner-Denver rock drills mounted for tunnel driving. In each drill, 85 stressed parts are produced from Nickel alloy steels. The Gardner-Denver Co. writes, "Through increased use of Nickel alloy steels, remarkable improvements in performance and reduction in maintenance costs have been accomplished—without comparable increase in weight or bulk."

• • •

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Noteworthy PATENTS

Compensates for Size

AUTOMATIC locking mechanisms are often required to provide a definite action from a position which might vary between operations depending upon the size of the product or object being processed. For instance, definite crushing action with compensating means to accommodate for variations is needed in nut cracking machines. Each small nut must be cracked sufficiently, yet the largest size must not have damaged meats through excessive crushing. An effective compensating means is provided in *Fig.* 1 whereby each nut is sized by a spring-yielding carriage which locks mechanically for the last portion of its stroke for cracking action.

Nuts to be cracked are delivered from a hopper by endless conveyor to a rotary nut holder as shown. The opening in the holder is inclined to allow continuous rotary motion during cracking operations. While passing between fixed and movable dies a crank advances movable die to contact nut. Additional movement of die is prevented by compressing a spring not strong enough to crack the nut shell.

Additional movement on forward stroke engages a preset "crush adjustment" which, by holding a piston against an advancing locking element, locks the carriage and movable jaw. The remainder of the stroke imparts the required preset cracking action to the nut shell. Thus regardless of size all nuts receive the same amount of cracking action.

Should a stone or other unbreakable object enter the cracking machine, reciprocating motion is unloaded by a spring between wrist pin and crank-link drive. Features of this design are covered in patent 2,196,444 assigned to The Champion Pecan Machine Co. by Leo J. Meyer.

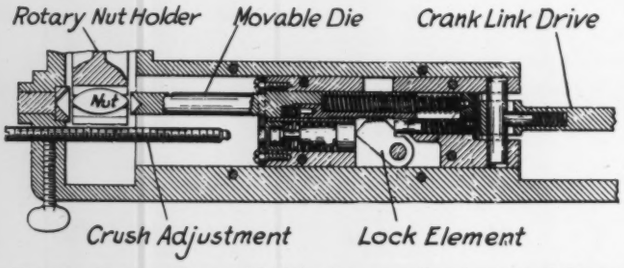


Fig. 1—Device has self-adjusting mechanism to deliver measured cracking force

Joint and Seal Are Compact

IN DIRECT-CONNECTED pumps like those used in aircraft for pumping gasoline, it is necessary to provide adequate seals against leakage of both gasoline from the pump and oil from the engine. Also because pumps of this type have no adjustment for wear it is important that no strains are encountered from any condition of misalignment of the drive. For this service

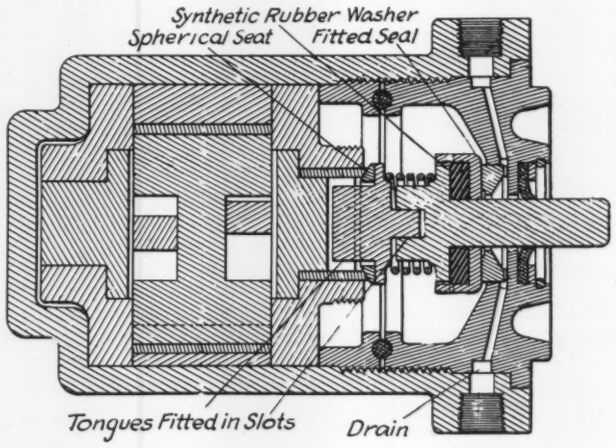


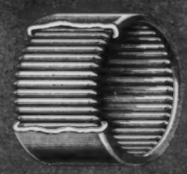
Fig. 2—Compact coupling is universal, chatterproof and serves to prevent leakage of fluid

Frederick W. Heckert has designed the pump shown in *Fig.* 2 embodying a close-coupled drive with universal joint and seals. Since pulsating characteristics of an engine would cause chatter in conventional universal joint designs, the joint used employs close-fitting tongue and groove members and a spherical seat. Covered by patent 2,192,588 this design is assigned to Curtis Pump company.

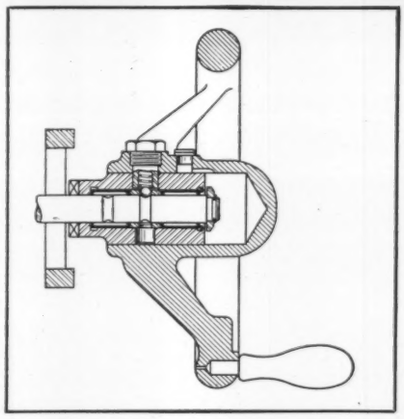
Hub on the inner end of drive shaft is transversely slotted. A similar slot is on the facing end of the pump rotor. Between the two is a fitted coupling member with tongues at right angles. A flange on this member butts a spherical washer seated in a matching recess in the driven shaft. This washer allows parallel displacement by transverse shifting and angular displacement by shifting of the spherical face.

A heavy coil spring is under considerable initial compression between face of coupling member and a flange

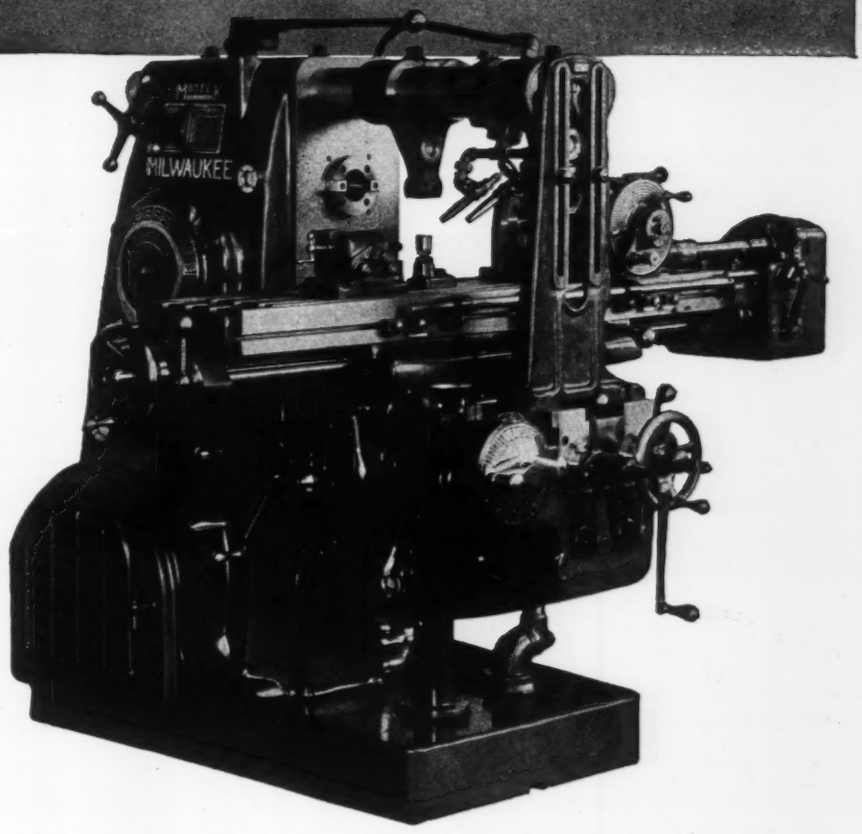
GREATER SPEED AND EASIER OPERATION



FROM TORRINGTON NEEDLE BEARINGS



(*Above*) Cross-section showing how a Torrington Needle Bearing is used in Hand Control Lever. The Torrington Bearing requires no more space than the conventional bushing it replaced.



(*Above*) The Kearney & Trecker Milling Machine in which Torrington Needle Bearings are used extensively to facilitate accuracy and ease of operation.

EASE in handling and speed of operation are important considerations when it comes to the purchase of milling machines. That's why engineers of Kearney & Trecker Corporation, manufacturers of the well known "Milwaukee" precision milling machines, were quick to appreciate the advantages of Torrington Needle Bearings.

Said the engineering department: "We replaced bronze bushings in the hand control levers with Torrington Needle Bearings. Our purpose was to minimize friction so that hand cranks will quickly assume a disengaged position when not operated. The Torrington Bearing was selected because of its small O.D. which required no more space than the bronze bearing it replaced. And," they add, "Torrington Bearings are also used extensively on various hand and power operated trip levers where *accuracy* and *ease of tripping under all load conditions* are essential."

Perhaps you, too, can profitably employ the many advantages of this unique Needle Bearing in *your* product. The Torrington Needle Bearing gives you the advantages of complete anti-friction operation, high-load capacity, efficient lubrication. It is a low-cost, compact unit that is easily installed, and is readily adaptable to modern product design.

For further information, write for Catalog No. 9. For data on Needle Bearings for use in heavier service, request Booklet 103X from our associate, Bantam Bearings Corporation, South Bend, Ind.

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
Makers of Needle and Ball Bearings

New York Boston Philadelphia Detroit
Cleveland Chicago London, England

TORRINGTON
NEEDLE BEARING

TRACING CLOTH
MUST HOLD AND PROTECT
THE BEST IDEAS OF
HIGHLY TRAINED MEN

OUR TRACING CLOTHS
ARE MADE TO BE
WORTHY OF THIS
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To transfer any work of value to Tracing Cloth classifies that work as permanent. The only safe way of determining the lasting qualities of the material is by referring to the established reputation of the manufacturer.

The Arkwright Finishing Co. has earned the reputation of satisfactorily supplying the exacting requirements of American draftsmen since 1921. Now, as then, Arkwright Tracing Cloths are noted for their uniformity of finish, high transparency and, most important of all, long life.

Arkwright considers Tracing Cloth a supply for the scientific field, not just an ordinary textile product. Insist on Arkwright Tracing Cloths for your important drawings – and see what a difference this emphasis on quality makes! Arkwright Finishing Co., Providence, Rhode Island.

Arkwright
TRACING CLOTHS

on the drive shaft. This presses the front face of a sealing cup against a sealing washer to prevent leakage from the pressure chamber surrounding it. Contacting faces are carefully ground, lapped, honed and polished.

Any slight leakage which may get through this joint accumulates in a recess behind the seal and passes through notches to a drain. Leakage either way along the shaft is retained by a secondary packing washer held in place by a washer and spring clip. This seal is designed to allow movement of shaft resulting from misalignment.

Minimizes Breakage

IN MANY machines requiring station operations it is necessary to start and stop the conveyor. This has disadvantages other than slowing up the process in that it complicates control functions and increases wear and the number of wearing parts. Intermittent starting and stopping of conveyor is obviated in a bottle capper by raising bottle from conveyor during sealing operations. As well as simplifying the design of the drive, this design allows sealing to be performed more quickly and reduces spillage due to intermittent operations. Designed by Abraham Podel and assigned

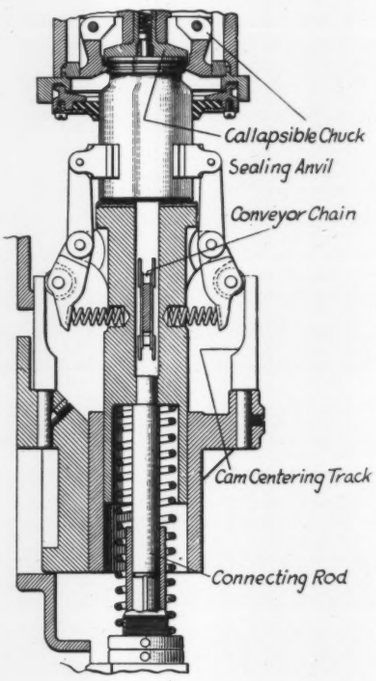


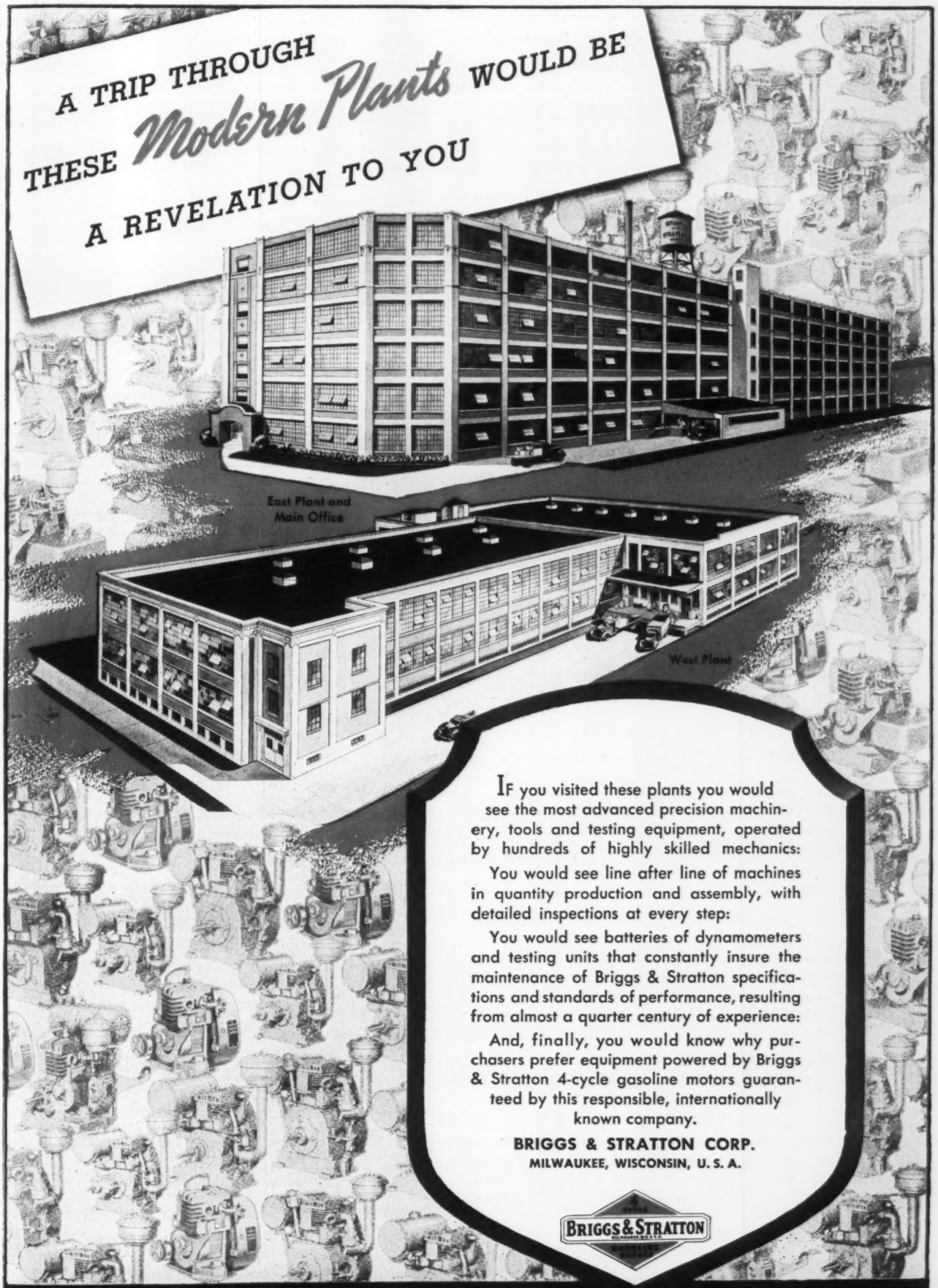
Fig. 3 — Sealing device does not require intermittent operation of conveyor

to Anchor Cap and Closure Corp., the container raising mechanism and vacuum sealing device are shown in *Fig.* 3 and covered by patent 2,193,113.

Container is lifted from conveyor on a platform raised by a spring-loaded connecting rod, cam operated. Raising of platform closes gripper jaws on glass. These jaws are centered by a cam track thus presenting container to sealer in its proper position. A flexible sealing member fits over container and allows sealing of cap under a vacuum if desired.

With cap in place, container presses against an anvil

A TRIP THROUGH THESE *Modern Plants* WOULD BE A REVELATION TO YOU



IF you visited these plants you would see the most advanced precision machinery, tools and testing equipment, operated by hundreds of highly skilled mechanics:

You would see line after line of machines in quantity production and assembly, with detailed inspections at every step:

You would see batteries of dynamometers and testing units that constantly insure the maintenance of Briggs & Stratton specifications and standards of performance, resulting from almost a quarter century of experience:

And, finally, you would know why purchasers prefer equipment powered by Briggs & Stratton 4-cycle gasoline motors guaranteed by this responsible, internationally known company.

BRIGGS & STRATTON CORP.
MILWAUKEE, WISCONSIN, U. S. A.

BRIGGS & STRATTON

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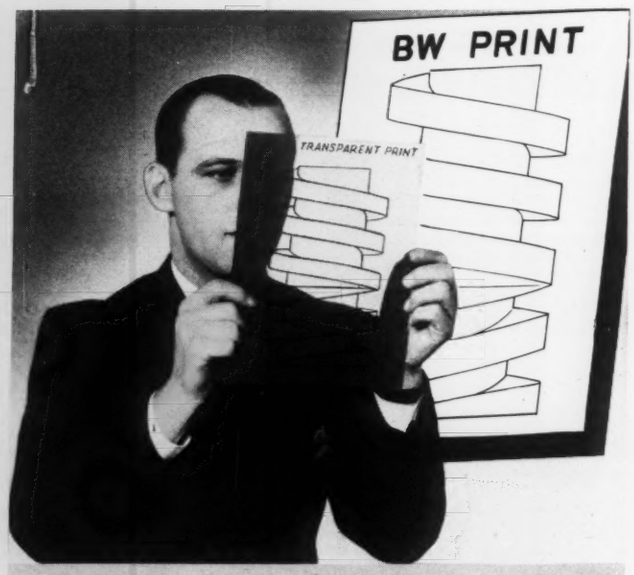

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It's the new Transparent BW Paper, outgrowth of long research to produce a transparent sensitized paper superior on *every* count!

Transparent BW Paper replaces negatives at much less expense and is much easier to use. Having the same transparency as tracing cloth, it prints at the same speed as Bruning BW Print Paper, and makes prints at practically the same speed as Bruning Vellux, the famous Bruning vellum. With Transparent BW Paper, the image is exceptionally opaque. The paper is flexible—easy to handle—non-curling.

Use Transparent BW Paper to protect your original tracings—make changes in detail or design quickly and easily. Our new booklet, "New Light on Prints," gives details about this new product—and provides a bird's-eye view of the advantages of the BW Direct Printing Process. Mail the coupon for your copy!

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and additional upward motion of the jar forces jaws inward crimping lid securely. Variations in container sizes are compensated for by self-adjusting spring. In this way breakage is prevented.

Completion of capping cycle returns the container to the conveyor which is timed to present the next container for sealing after release of the one previously sealed.

Fluid Flows Between Pistons

DOUBLE acting shock absorber as illustrated in *Fig.* 2 has balanced opposed pistons designed to preclude leakage paths for hydraulic fluid. Also, arrangement is extremely compact aiding utilization in locations with restricted space. Designed by Edwin F. Rossman, Henry O. Fuchs and Robert B. Burton, this design is covered by patent 2,191,942 assigned to General Motors Corp.

Shape of cam surfaces causes identical but opposed

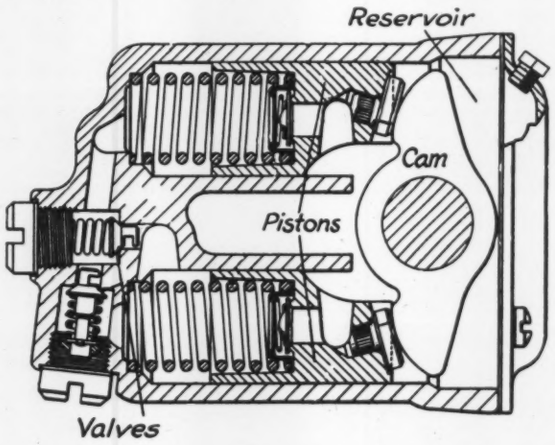


Fig. 4 has balanced opposed pistons designed to *sorbers provides compact unit*

movements of the pistons so that each will move with equal rates. Cam has wide flat surfaces to prevent any rotation of pistons, allowing cut out portions of pistons to nest for compact design. Spring loaded valves give desired resistance to piston movement by restricting fluid flow between chambers.

End-to-end discharge causes the hydraulic fluid to flow direct into the opposite displacement chamber. Equal movements in this way obviate the necessity of forcing fluid through leakage paths around the pistons. Helical springs keep wear pieces on piston ends in contact with cam surfaces at all times and assure proper quick response of pistons to any reverse movement of cam arm.

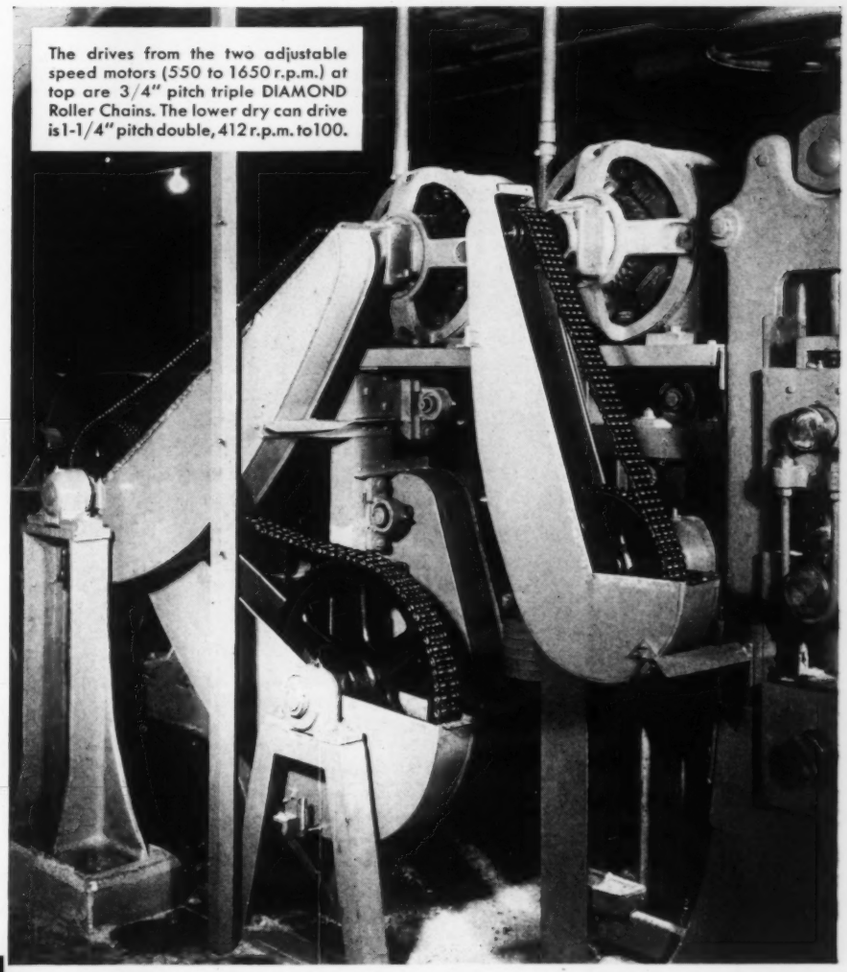
Sales of Cone-Drive worm gearing for the first quarter of 1940 showed an increase of 94 per cent compared to the first quarter of the preceding year, according to the Cone Worm Gear Division of Michigan Tool Co. This includes only gearing produced for sale, not for use in any of the company's products. Orders on hand are three times the total sales for 1939.

Over a Mile of DIAMOND Roller Chain

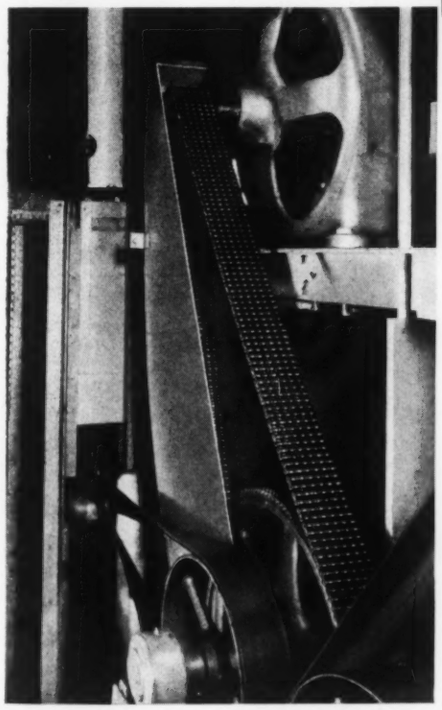
•

129 Drives since 1931 —54 more in 1939

Since the first applications in 1931, one of the most prominent textile mills in the Carolinas has added DIAMOND Drives every year—54 more being placed in service in 1939.



The drives from the two adjustable speed motors (550 to 1650 r.p.m.) at top are 3/4" pitch triple DIAMOND Roller Chains. The lower dry can drive is 1-1/4" pitch double, 412 r.p.m. to 100.



35 H.P., 8-foot center, Vari-speed drive on starch mangle—3/4 in. pitch sextuple DIAMOND Roller Chain—speed variations 1650/550 r.p.m., sprockets, 20 and 132 teeth.

Wide Application

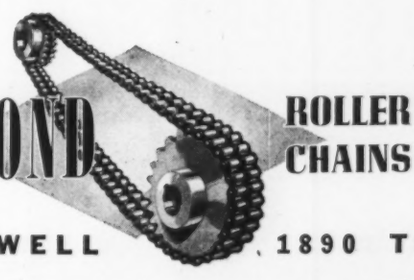
The drives are on printing machines, starch pads, mangles, washers, dye pads, Tommy Dodds, mercerizers, dry cans, soapers, acid agers, calenders, from vari-speed motors. The drives cover a wide range of capacities from 1 hp. to 40 hp.

"No-Slippage" an Important Advantage

The motors are adjustable-speed types, and slippage between motor and driven shaft can not be tolerated. Top performance of all machinery production is accurately pre-determined and various machines and groups of machines must be synchronized and kept that way regardless of speed adjustments made.

Longer Life Another Advantage

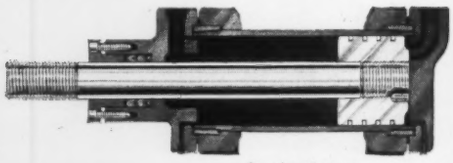
Long life, fewer delays, quietness, are also important advantages here as well as wherever motor-driven equipment is used—and you get all these with low initial and maintenance costs. Our Drive Data Book makes selection easy—write for a copy for your files. DIAMOND CHAIN & MFG. CO., 435 Kentucky Ave., Indianapolis, Indiana. Offices and Distributors in All Principal Cities.



DIAMOND ROLLER CHAINS

50 YEARS OF DOING ONE JOB WELL . 1890 TO 1940

PRACTICAL HYDRAULIC CYLINDER ADVANTAGES

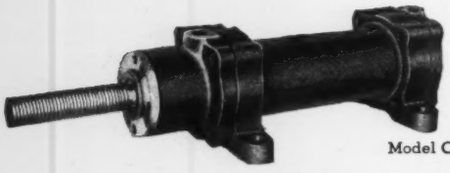


Sectional view

Hannifin hydraulic cylinders are stronger, simpler, and offer a wide range of standard types for easy application to many different kinds of uses. The advantages of hydraulic power, with its smooth action and ease of control, are more readily available with this patented cylinder design.

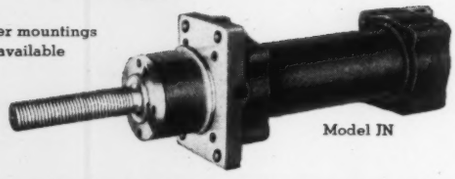
Check these Hannifin features: **No tie rods.** End caps may be removed without collapse of other parts. **Universal end caps.** May be positioned independently with inlet at top, bottom or either side. **Air vent plugs.** Each cap has air vents on three sides. **Leakproof.** Precision construction with mirror finish honing of the cylinder bore gives a straight, round, perfectly smooth cylinder bore, better piston seal, and minimum fluid slip.

Construction and finish are identical in all sizes of Hannifin cylinders. Built in seven standard mounting types, with small diameter piston rod, 2 to 1 differential piston rod, or double end piston rod, with or without adjustable cushion. All sizes, for working pressures up to 1000 and 1500 lbs. per sq. in. Other types built to order, any size, for any pressure. Write for Bulletin 35-MD with complete specifications.



Model CN

Other mountings available



Model JN

HANNIFIN MANUFACTURING COMPANY
621-631 South Kolmar Avenue • Chicago, Illinois

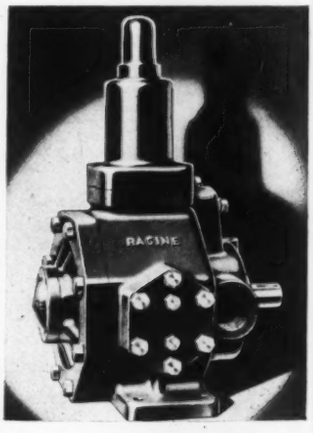
ENGINEERS • DESIGNERS • MANUFACTURERS
Pneumatic and Hydraulic Production Tool Equipment

HANNIFIN
HYDRAULIC CYLINDERS

New PARTS AND MATERIALS

Hydraulic Pump Rated 1000 Pounds

COMPLETION of a new model variable volume hydraulic pump is announced by Racine Tool & Machine Co., Racine, Wis. Rated at 1000 pounds continuous pressure, this pump has a shaft of much larger diameter, with a wide margin of safety against deflection under maximum load or shock. Taking the radial load, needle bearings are wider and larger in diameter. A ball thrust bearing has been added to carry any possible end thrust. Oil seals are the mechanical self-compensating type, preventing leakage at the shaft end and sealing against atmospheric pressure only. Vanes and rotors are heat treated, hardened and ground, with vane slots now slanted away from the direction of rotation, permitting use of wider vanes having greater strength. Greater thickness of metal between the bottom of slots and the shaft hole is also permitted. Hydraulic balancing of the vanes, always a feature of the company's pumps, is now accomplished by an improved porting of the side plate, of hard special bronze. In addition to the variable volume constant pressure feature, obtained by a simple type of hydraulic governor, these pumps are also furnished with a manual handwheel for positive control of volume. Another combination consists of a dual pressure control, operated either hydraulically or electrically, permitting maximum volume at low pressure —for rapid traverse movements—and minimum volume or deadhead holding at high pressures.



Shaft of much larger diameter, with wide margin of safety against deflection under shock is feature of variable volume hydraulic pump

Switch Has Small Actuating Movement

HANDLING a direct current load of 17 amperes at 125 volts, or 8.5 amperes at 250 volts, the new type D Mu-Switch makes available an efficient, economical means of directly controlling relatively heavy noninductive loads on direct current with an actuating movement of only .0015-inch. Announced by the Mu-Switch Corp., Canton, Mass., this switch occupies a space only 2-5/16-inch long, 13/16-inch wide,

THE STORY OF

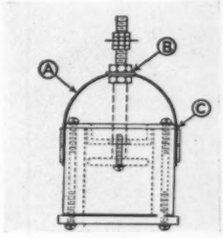
The dashpot that kept its hat on!

[How an engineer clamped on the lid for more than 30,000,000 piston strokes!]

"I'VE GOT IT, chief!" yelled an engineer, bursting into the office of the superintendent of a large power plant. "We'll put a hat on it!"

"We'll put a hat on *what?*" asked the superintendent.

"On this dashpot," said the engineer, holding out a blueprint. "We've never used a dashpot that wouldn't leak oil sooner or later. And you know how expensive it is to shut down our generators and repair the dashpot. It occurred to me that a sort of a hat—a resilient seal—covering the dashpot cylinder would hold the oil in . . . and still give the piston enough play!"



Cross section of dashpot shows neoprene seal (A). By coating the cylinders and washers with neoprene cement an air-tight seal is obtained (B and C).

The idea looked fine—on a blueprint. But where would he find the right material for that hat—a material that was tough, flexible and oil-resistant, all at the same time?

One material after another failed to meet these requirements. Some would be loosened by the continuous action of the dashpot piston. Others would quickly lose their flexibility. And still others would deteriorate from the effects of the heavy oil.

Finally he put neoprene to the test. Equipped with a tiny neoprene seal, the dashpot survived 30,000,000 complete cycles of the piston—and didn't even tip its hat! Tough, flexible, oil-resistant, it sat on that bouncing piston, holding the oil inside and the air out!

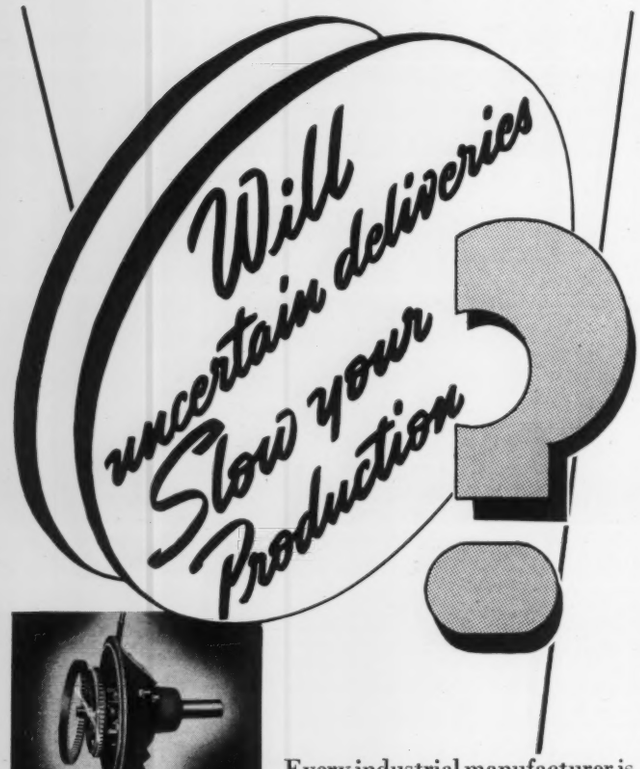
Just another example of neoprene's versatility. This remarkable chemical rubber has all the strength, resilience and toughness of natural rubber . . . *plus* resistance to oil, heat, gasoline, oxidation, aging and corrosive acids and gases.

For interesting news about this problem-solving product, write for the *Neoprene Notebook*. E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division, Wilmington, Delaware.

DU PONT

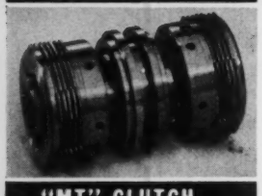
NEOPRENE

The Chemical Rubber



POWER TAKE-OFF

"CL" CLUTCH


"MT" CLUTCH

MARINE GEAR

TORQUE CONVERTER

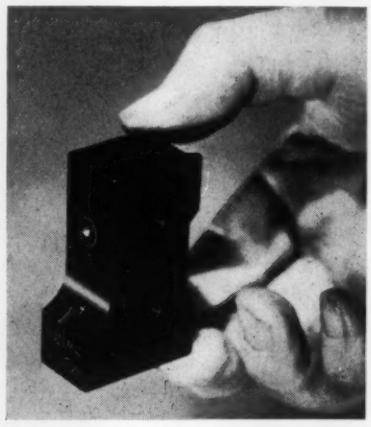
Every industrial manufacturer is facing an unprecedented "run" on his sources of supply . . . a test of the preparedness of those on whom he depends for material . . . their resourcefulness in meeting unusual demands.

The Twin Disc Clutch Company's flexible organization . . . their 23 years as clutch specialists . . . their accurately controlled inventories . . . their adequate parts and service stations . . . assure Twin Disc customers against serious delays, delivery failures, or bottle-necking of the assembly line.

Inquiries welcomed concerning any of the products illustrated. A complete staff of competent engineers are available for any power transmission problem. Write or wire Twin Disc Clutch Company, 1325 Racine St., Racine, Wisconsin.

TWIN DISC CLUTCHES
REG. U. S. PAT. OFF.

and 1⅜-inch high. Having contacts of a special nonsticking alloy and a powerful magnetic blowout device for arc suppression, this switch does not need capacitors or resistors to protect contacts. The housing is molded plastic capable of withstanding tempera-

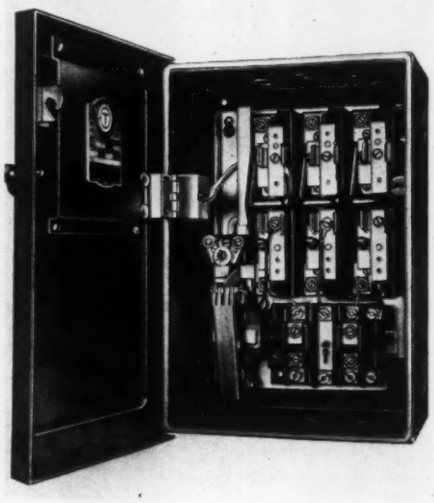


Relatively heavy noninductive loads on direct current are directly controlled by new small switch

tures up to 900 degrees Fahr. Large electrical screw terminals with cup washers are provided on the bottom of the housing, permitting heavy wire leads to be directly connected.

Starters Simplify Application

BUILT-IN application of new combination magnetic starters announced by Trumbull Electric Co., Plainville, Conn., is simplified because the quick-make, quick-break mechanism is a part of the interior assembly and not of the box. Hence these units may be used without boxes. Starter and disconnect are assembled on the same base, making for unusual compactness. Maintenance is made easier because of interchangeable con-



Make, break mechanism for combination magnetic starters is part of interior assembly, simplifying application

tacts on starter and disconnect. Contacts are vertical, self-wiping, double-break type. All parts are accessible and removable from the front and wiring is straight-through. The starters are available in size 1, maximum capacity 7½-horsepower, and size 2, maximum 25-horsepower.

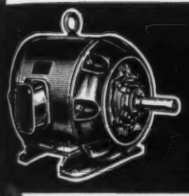
Strip Thermostat Introduced

KNOWN as the NS strip type, a new thermostat has been placed on the market by George Ulanet Co.,

Select a WAGNER MOTOR and be sure of the RIGHT Motor for the job

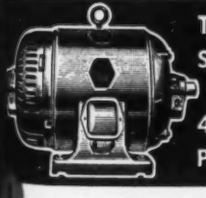
Type RP
Squirrel-Cage
Open—Ventilated
1/6 to 400 hp
Polyphase

Type CP
Squirrel-Cage
Totally-Enclosed,
Fan-Cooled
1½ to 125 hp
Polyphase

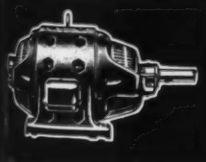


Type HP
Explosion-Proof
1½ to 125 hp
Polyphase

Type RS
Wound Rotor
(Slip-Ring)
1 to 250 hp
Polyphase



Type RT
Special Compressor
Motor
40 to 100 hp
Polyphase



Type RN
Fynn-Weichsel
(Synchronous)
7½ to 200 hp
Polyphase

No matter what type of equipment you are designing...whether large or small...regardless of the torque, speed or current requirements, you can choose a motor from the Wagner line that is correctly engineered for the job. The twelve motors shown here are merely representative of the Wagner line. Each motor has special electrical or mechanical characteristics that make it the ideal motor for certain applications.

1. Type RP—Available in 7 electrical types: Normal-Torque, Normal-Starting-Current; Normal-Torque, Low-Starting-Current; Low-Torque, Low-Starting-Current; High-Torque, Low-Starting-Current; High-Torque, Normal-Starting-Current; High-Torque Punch-Press; High-Torque Elevator; High-Torque Crane and Hoist.

2. Type CP—Available in the same 7 electrical types as the RP. Totally-enclosed for protection against dust, fumes and moisture. Double-frame construction. Fan mounted between outer frame and dust-proof inner frame cools the motor.

3. Type HP—Explosion-Proof motors have been approved by the Underwriters' Laboratories for Class 1, Group D hazardous locations where gasoline, petroleum, naphtha, alcohols, acetone, lacquer solvent vapors and natural gas are manufactured, used or handled.

4. Type RS—For constant or adjustable varying speeds on elevators, cranes, hoists, crushers, triplex pumps. Start heavy loads smoothly without objectionable line disturbances. Smooth starting and varying speeds are effected by the use of external resistors.

5. Type RT—Developed to meet the demand for a motor with high starting-torque and very low starting-current. Ideal for large compressors. The very low starting-current permits across-the-line starting.

6. Type RN—For power-factor correction and constant speed at all loads. High starting-torque and high pull-in torque.

7. Type RA—Brush-lifting motors having high starting-torque and low starting-current. The ideal motor for heavy duty application such as mechanical refrigeration, air-compressors, pumps, stokers, etc. Sleeve or ball bearings; open, totally-enclosed and drip-proof; rigid, resilient and flange mounting.

8. Type RG—Brush-riding motors with high starting-torque and normal starting-current. These motors have smooth starting characteristics.

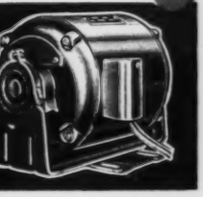
9. Type RB—Extremely quiet in operation and particularly adapted for oil-burners, unit-heaters, fans, blowers, and hundreds of other home, office and factory appliances. Sleeve or ball bearings; open, drip-proof or totally-enclosed; rigid, resilient and flange mounting.

10. Type RK—Suitable for driving refrigerators, household air-conditioners, stokers, oil-burners and other similar types of equipment. Drip-proof or totally-enclosed endplates; rigid or resilient mounting.

11. Type M—Induction motor of simple construction. Ideal for fan and blower drives in which the fans are mounted directly on the motor shaft. Totally-enclosed and open type; rigid or resilient mounting.

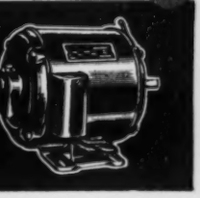
12. Type RD—For direct current service. Built in two types; appliance type up to 1½ hp; industrial type, 2 and 3 hp.

Type RA
Single-Phase
Repulsion-Start-
Induction
1/8 to 15 hp



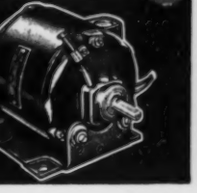
Type RG
Single-Phase
Repulsion-Induction
1 to 5 hp

Type RB
Split-Phase
General Purpose
1/20 to 1/3 hp

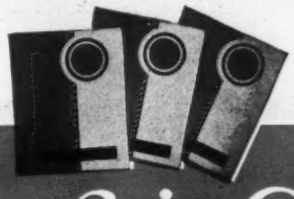


Type RK
Single-Phase
Capacitor-Start,
Induction-Run
1/8 to 3/4 hp

Type M
Single-Phase
Shaded-Pole
Fan Motor
1/250 to 1/30 hp



Type RD
Direct-Current
(Compound Wound)
1/8 to 3 hp

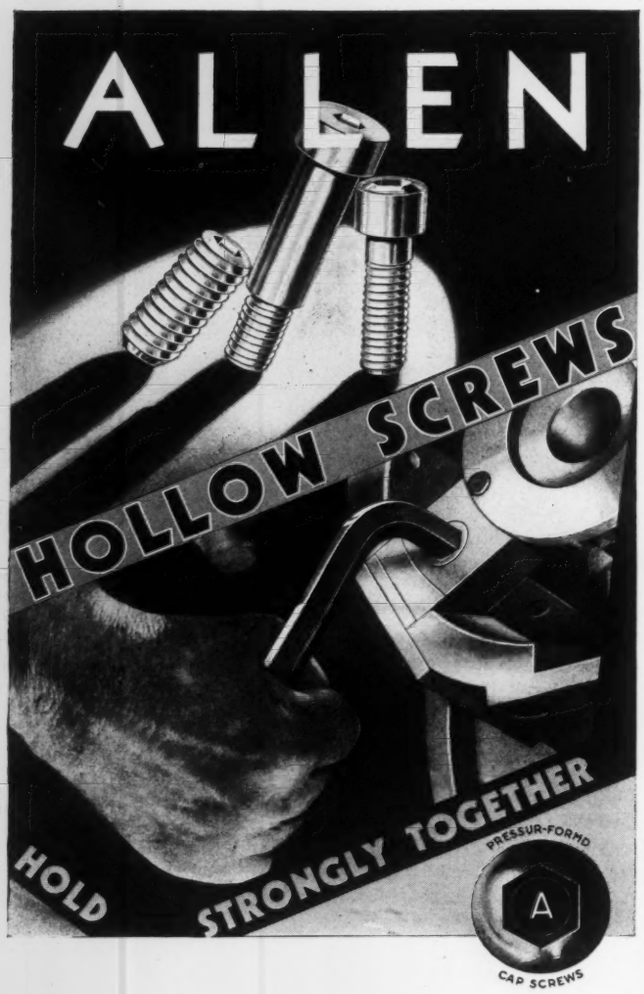
Send for these Free Motor  *Bulletins* MU-177, 179 & 182 *Today*

M40-15

Wagner Electric Corporation

6400 Plymouth Avenue, Saint Louis, Mo., U.S.A.

MOTORS • TRANSFORMERS • FANS • BRAKES



Duty-bound

— to hold *without fail* the assembled parts of machines, their adjustments and set-ups;

— to *speed up* assembling and setting-up, by use of hand, spiral or power drivers applied to the Allen hex keys;

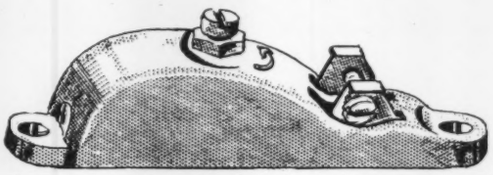
— to help simplify machine design, by means of STRONGER *hence smaller* screws, smaller machine parts, streamlined compactness;

— to serve as "little pillars of strength" *upholding* production schedules all through your shop . . . Ask for samples to test for the qualities *YOU* want most.

Your local Allen Distributor will oblige with samples and SERVICE.

THE ALLEN MANUFACTURING COMPANY
HARTFORD, CONN., U. S. A.

88 East Kinney street, Newark, N. J. With a temperature differential of 5 degrees Fahr. the thermostat has temperature ranges of from 0 to 350 degrees and 350 to 700 degrees Fahr. Electrical rating is 1500 watts at

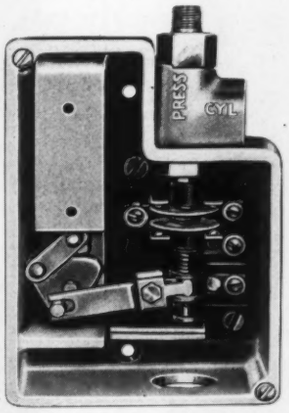


Thermostat has temperature differential of five degrees Fahr.

115 to 230 volts alternating current. It has a sturdily constructed bimetallic thermal element provided with heavy electrolytic silver contacts, mounted in an aluminum cast housing.

Pilot Air Valve Is Three-Way

THREE-WAY pilot type solenoid valve, with momentarily energized single operating coil is announced by Automatic Switch Co., 41 East Eleventh street, New York. For air at pressures to 75 pounds, this new valve is particularly well adapted for air conditioning and heat control because it is tight seating and free from alternating current hum. A cast aluminum box includes the valve body as an integral part and forms a casing for the single coil operating movement, control contacts and terminals. The solenoid and simple operating mechanism is so arranged that energization of the solenoid through a three-wire control circuit acts to close



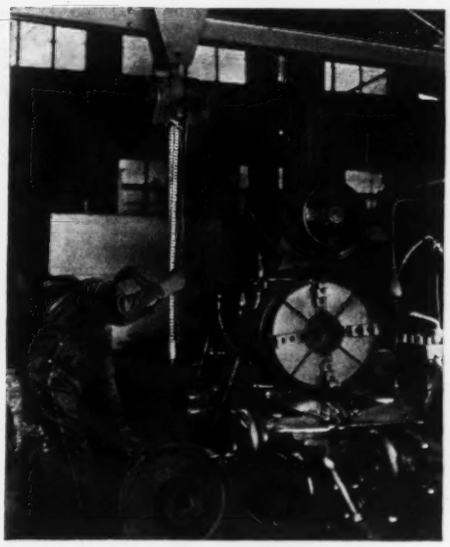
Valve is particularly adapted to air conditioning and heat control, handling air at 75 pounds pressure

the port which is open and simultaneously opens the port which is closed, thus applying pressure to the diaphragm or cylinder, or exhausting pressure from it. The coil circuit is opened, after momentary energization of the solenoid, by contacts mounted with and operated by the solenoid, and the valve is mechanically held in either position without continued application of current. Control station makes but never breaks the operating current, thus permitting use of delicate control contacts.

Vertical Pulley Bearing Oils Self

VERTICAL tension pulley bearing for textile machinery is announced by New Departure division, General Motors Corp., Bristol, Conn. Identified as TP-13-500, this bearing not only provides a vertical stub shaft

What Design Engineers are doing with SILVERLINK ROLLER CHAIN



↑ Light Weight Electric Hoist Uses Silverlink

The "Budgit" Hoist, which is a product of the Shaw-Box Crane and Hoist Division of Manning, Maxwell and Moore, Inc., weighs only 58 pounds and has a 500-lb. lifting capacity at a speed of 17 ft. per minute and operates from light socket, with no additional wiring required. To obtain the performance that this new hoist gives, with a unit so light in weight, Silverlink roller chain, instead of the usual link lifting chain, is employed.

HIGH strength, great flexibility, accuracy, smoothness, stability and long life are features of Silverlink Roller Chain which help speed work and cut costs.

A complete range of sizes, sprockets and attachments simplify any conveyor or drive problem. And Link-Belt's abundant experience and effective engineering help are at your command.

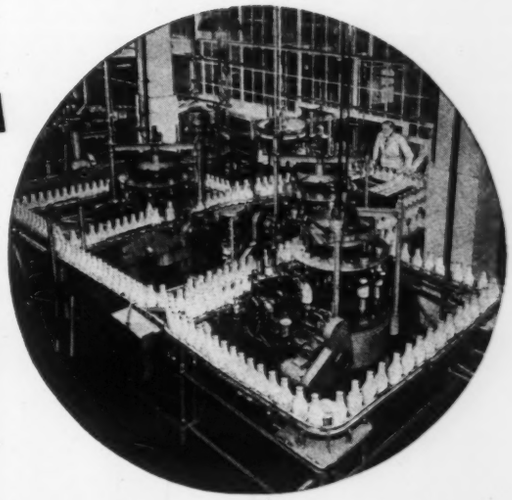
Send for Roller Chain Engineering Data Book No. 1757.

●

LINK-BELT COMPANY

Indianapolis, Chicago, Philadelphia, Atlanta, Dallas, San Francisco, Toronto. Offices, warehouses and distributors located in principal cities.

7940-E

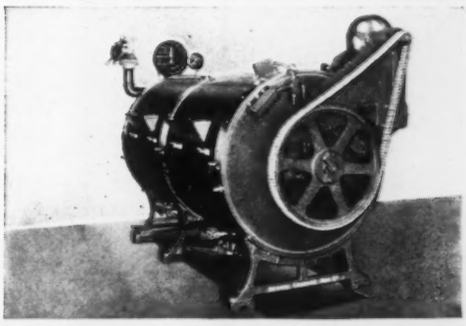


Operates in ↑ Two-Planes

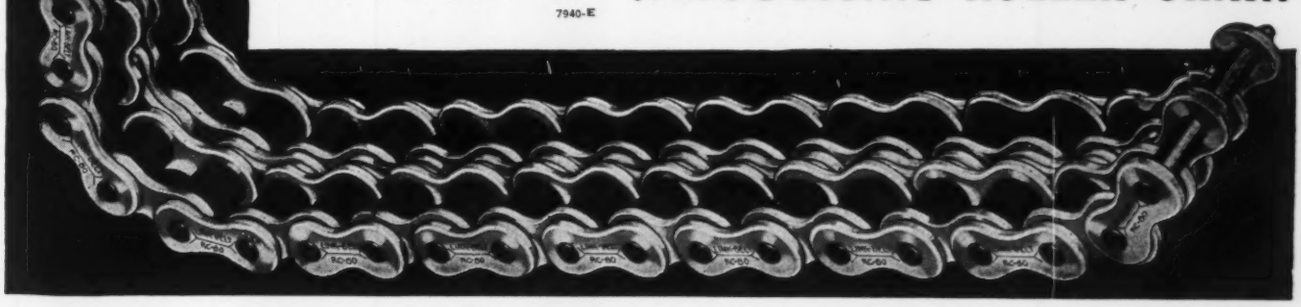
The Universal Carrier Roller Chain is an accurately made finished steel chain equipped with a steel carrier or top plate for handling bottles, jars, and cans in the process of manufacture, and in cleaning, filling and capping operations. This chain permits sprocket engagement in two planes and is accurately made of finished steel to operate over cut-tooth sprocket wheels, resulting in exceptionally smooth conveyor movement. The two-plane travel feature makes it practical to use this chain in rectangular, circular, semi-circular or irregular paths, or employ one long conveyor, if desired, instead of requiring several transfer conveyors with individual driving mechanisms.

↓ Hospital Laundry Machine Quiet, Dependable

The Henrici washing machine employs a Link-Belt Silverstreak silent chain drive on the first reduction from the motor, and a triple-width Link-Belt Silverlink roller chain from the first reduction to the sprocket wheel on the washing machine cylinder. The Henrici organization states that hospital engineers and mechanics are enthusiastic about the silent, smooth operation of these chain drives, that they give smoother acceleration, that they have simplified the matter of lubrication, made adjustments easier, and have practically eliminated repair expense.



LINK-BELT
Silverlink ROLLER CHAIN



OHIO GEARS

IN THE UNA AUTOMATIC ARC WELDING HEAD

• An unusual gear problem confronted the engineers of the Una Welding Co. in developing the Una Automatic Arc Welding Head. To insure perfect welding, the rod must be fed toward the work at such a speed that a predetermined arc length will be constantly maintained. Two motors are used; a variable speed, controlled by the arc voltage, advances the rod; a constant speed withdraws the rod when necessary. Differential gears connect these to the feed rolls and any possibility of backlash in these gears must be reduced to a minimum. This calls for unusual gear accuracy in both cutting and assembly.

Ohio Gears have been the continuous, exclusive choice of Una engineers for two reasons —(1) skilled engineering assistance in developing the drive, (2) continued satisfaction with Ohio Gear Co. products and services.

Put Ohio Gear to work on your gear problems. You'll find it a highly satisfying, profitable move.

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Kansas City Rubber & Belting Co.
712 Delaware Street

*SAN FRANCISCO, CALIF.
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Alfred Halliday, 330 Starks Bldg.

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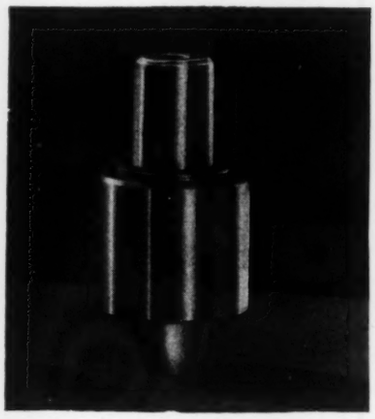
518 North Delaware Street

ST. LOUIS, MO.
St. Louis Tool Co.
2319 N. Ninth Street

Stocks carried.

OHIO GEARS

on which the pulley is mounted, but it contains its own oil circulating system for speeds of 3500 to 15,000 revolutions per minute. By this system, oil is drawn from a reservoir below the bearing and is passed in a fine spray directly to the balls or races. Since the bearing is the self-sealed type with all metal seals, the oiling system is completely enclosed and oil need not be added, except at yearly intervals. No locknuts, screws or other parts are needed to mount this bearing.



A vertical stub shaft is provided in vertical tension pulley bearing, and it contains its own lubricating system

Valve Developed for Oil Dilution

PRIMARILY for aircraft use, a new valve has been developed by Aeronautical Mfg. Corp., 166 Chandler street, Buffalo, N. Y., for use in oil dilution systems when gasoline or other fluids are used to dilute the engine lubricating oil in order to assist in cold weather starting. Actuation is by means of an electric solenoid, the valve being closed by a positive acting spring. In test, aviation gasoline was used under a pressure of 50 pounds per square inch and the valve was operated over 26,000 cycles, without signs of wear or leakage.

Actuation of valve for oil dilution systems in aircraft is by means of solenoid, valve being closed by positive acting spring

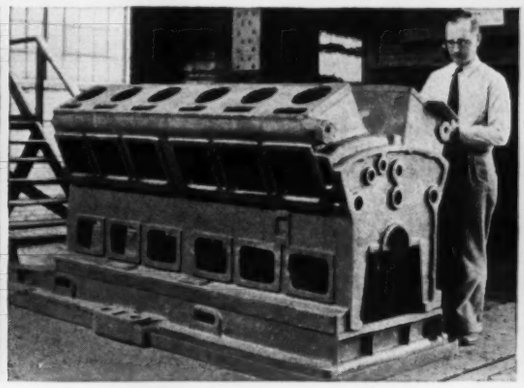
Hydraulic fluid was substituted for the gasoline and pressure was carried up to 800 pounds per square inch, and satisfactory operation was still obtained. This electric valve is available for six or 12 volts direct current operation and it can also be used for other direct current voltages when placed in series with a suitable resistor. It can be supplied for either one or two-wire electric circuits and uses a standard electrical quick disconnect type of fitting.

Float Switch Controls Sump Pump

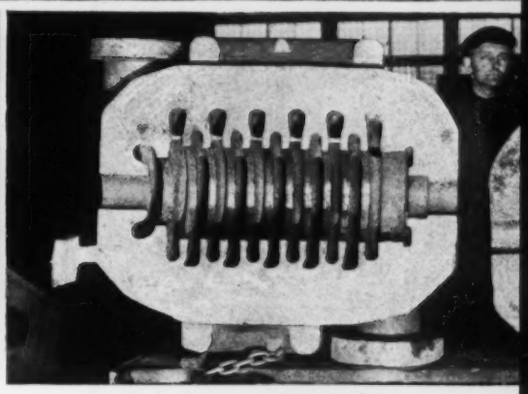
FOR domestic sump pump control, a new float-switch is announced by the General Electric Co., Schenectady, N. Y. Employing an overcenter toggle mechanism, it is a single pole switch whose float-rod

Get these Advantages for Your Product with STEEL CASTINGS

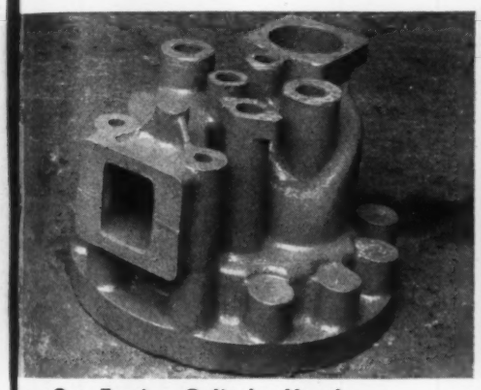
Airplane Landing Gear Parts
SAFETY—Through uniform structure, greater strength—shock and stress resistance.



Diesel Engine Frame and Base
SCIENTIFIC WEIGHT DISTRIBUTION—Maximum strength exactly where needed, with minimum weight.

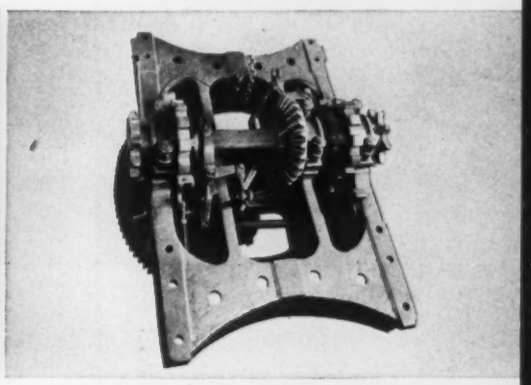


High Pressure Pump Casing
RESISTANCE TO PRESSURE and high temperature—wide range of mechanical properties available.



Gas Engine Cylinder Head
LESS MACHINING—Streamlined appearance—lower manufacturing cost.

Excavator Gears and Pinions
CAST TO FINAL SHAPE—Little or no excess metal to pay for or trim off.

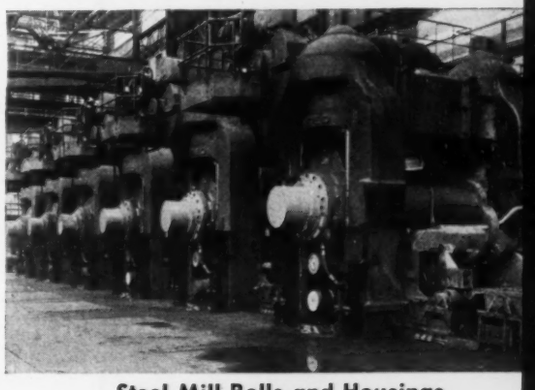


Power Shovel Truck Frame
HIGH RIGIDITY, minimum deflection under stress, accurate alignment, better fit.

Hydroelectric Turbine Runner
INTRICATE SHAPES cast as units—save finishing and assembly time—reduce costs.

Whatever you manufacture, you can improve and modernize your product with Steel Castings, and often reduce substantially your production costs.

Your local foundry will gladly consult with you, or you may write—without obligation, of course—to Steel Founders' Society, 920 Midland Building, Cleveland, Ohio.



Steel Mill Rolls and Housings
RESISTANCE TO SHOCKS and stresses. Any desired heat treatment available.

STRENGTH PLUS ECONOMY WITH

STEEL CASTINGS

A Symbol of Perfection

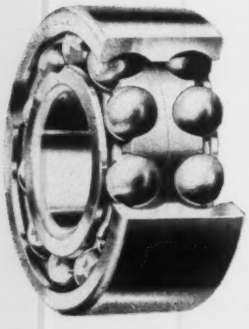
The metal plate shown above is a symbol of the perfection and quality built into the equipment to which it is attached. The name McGILL on a bearing is your assurance of real value and satisfaction in performance.

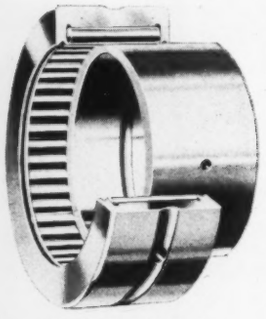
Universally Used

You will find McGILL Bearings, both ball and needle type, being used regularly in fine machinery — printing presses, motors, diesel engines, boring machines, generators, steam shovels, locomotives — in trucks — in automobiles. These precision bearings have demonstrated their ability to stand up, under a wide range of requirements over the years. They have incorporated in them features of construction not regularly found in other bearings, that result in economies in first cost, in installation cost, and in upkeep—benefits worth considering.

Write for further particulars.

New McGILL Maximum Capacity Ball Bearing





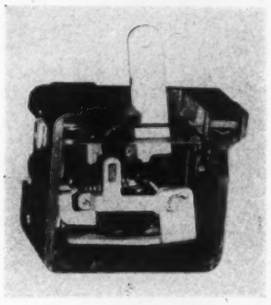
McGILL Solidend *MULTIROL* Bearing

Send for Catalog — BEARING DIVISION

McGILL MANUFACTURING CO.
1450 N. Lafayette Street
VALPARAISO, INDIANA

weight is counterbalanced by a calibrated spring acting on the operating lever. Other features include corrosion-resistant parts which permit operation under severe moisture conditions, accessible terminals for easy wiring, a dummy terminal to provide convenient

Overcenter toggle mechanism is employed in float switch for domestic sump pump control

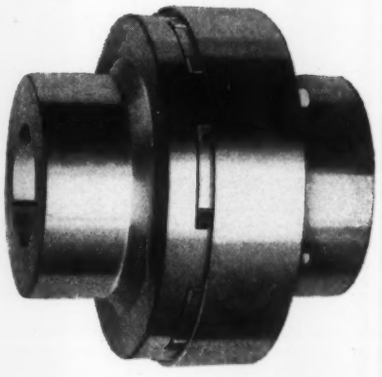


wiring of the "through" side of the line, fine-silver contact tips and snap-action mechanism. Design of the sump pump is simplified because the new control is built for mounting in the motor end-shield or some suitable part of the pump.

Coupling Has Greater Capacity

NONLUBRICATED heavy duty flexible coupling designated L-R type H, is announced by Lovejoy Flexible Coupling Co., 5018 West Lake street, Chicago. Cast from high grade electric steel, it has a greater number of jaws than previous types and is therefore claimed to have 80 per cent greater load carrying capacity. Individual load cushions are free floating between the metal jaws and rest upon the central hub, being firmly and safely secured in place by an endless steel floating cushion retainer or collar. Cushions are

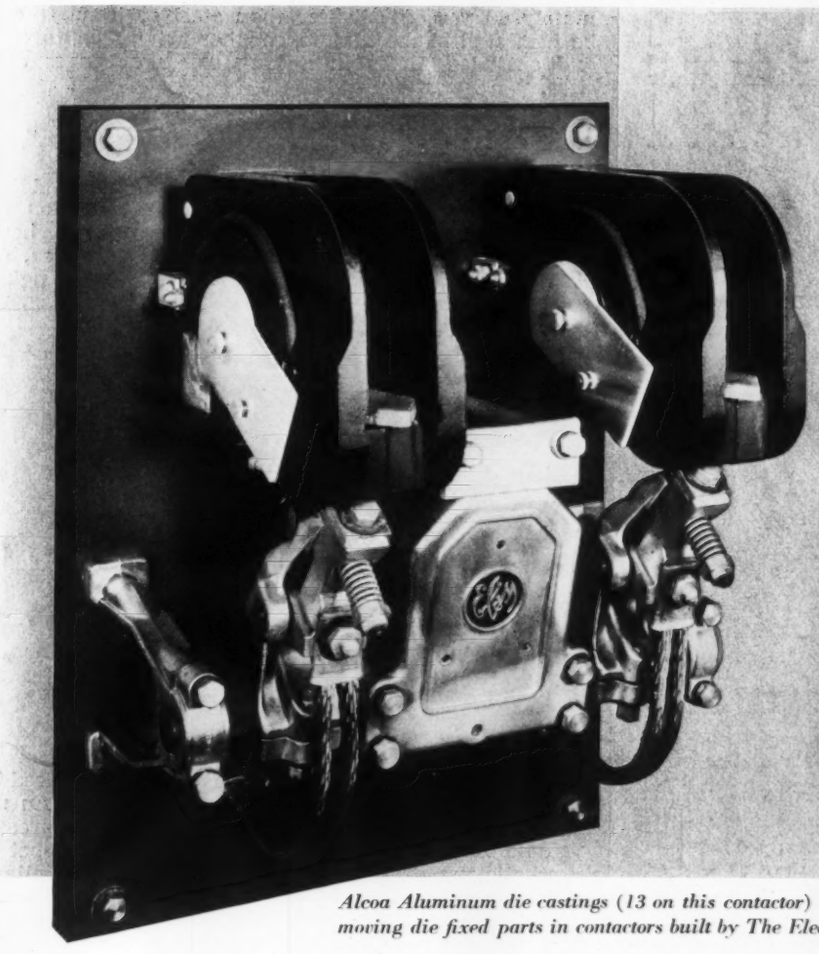
Individual load cushions are free floating between metal jaws in nonlubricated heavy duty type flexible coupling



free to move and adjust themselves instantly to any momentary position of the jaws and are always in plain sight for inspection. In operation, one-half of the cushions are idlers, except on reversing loads, and hence there is always a set of new cushions in the coupling. These couplings are made in standard sizes with bores from 1½ to 14-inch, for 5 to 3000-horsepower at 100 revolutions per minute.

Light Alloy Available

NO. 301, a new alloy, is announced by the Colonial Alloys Co., Philadelphia, with the following characteristics: Ultimate tensile strength, 72,110 pounds per square inch; elongation in 2 inches, 32 per cent; yield point, 57,530 pounds per square inch; reduction of area, 16.5 per cent of original section. Nonmagnetic and nonsparking, this alloy is rustproof and approxi-



It's HAMMER HAMMER HAMMER

Alcoa Aluminum die castings (13 on this contactor) have proved their dependability on many moving die fixed parts in contactors built by The Electric Controller & Mfg. Co. of Cleveland.

No delicate materials can be used here. If you've ever listened to electrical contactors slamming shut, you know the repeated shocks and beatings their parts must take.

On EC&M magnetic contactors, moving parts are Alcoa die castings made of strong Aluminum Alloys. These die castings not only have adequate strength, endurance and electrical conductivity, but their light weight provides the low moment of inertia that is so important for lightning responses to demands of modern, quick-operating machinery.

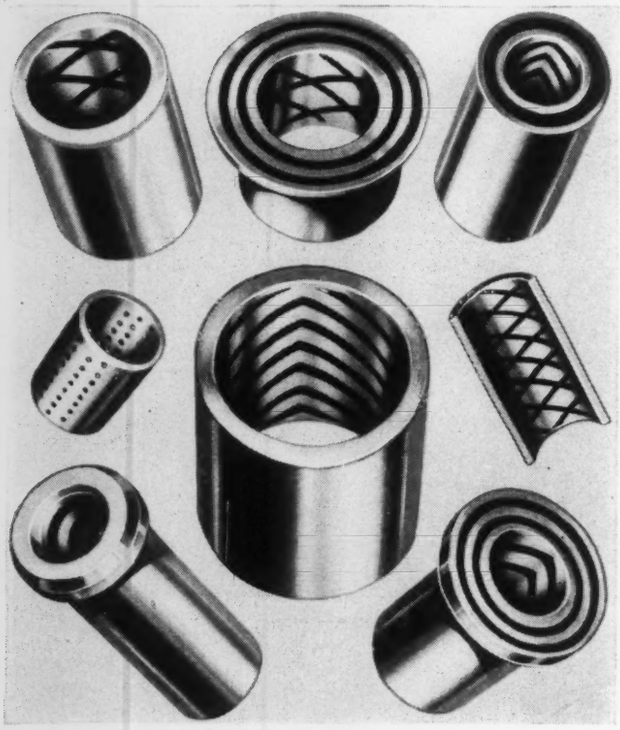
Steel inserts are cast integrally with the Aluminum for contactor arms that must respond to magnetic pull. Threaded brass inserts are included in the same way. So accurate are these die castings, that very little finishing is required.

This successful use of Alcoa die castings should suggest possibilities for your products. May we discuss them with you?

ALUMINUM COMPANY OF AMERICA, 1940 Gulf Building, Pittsburgh, Pennsylvania.

ALCOA ALUMINUM

FOR BETTER MACHINES AND APPLIANCES



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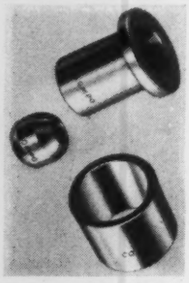
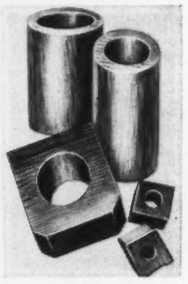
Bound Brook

CAST PHOSPHOR BRONZE GRAPHITED BEARINGS
Inlaid with hard, enduring graphite lubricant, in holes or grooves of various patterns. Cover the shaft with a film of graphite lubricant, reducing friction and maintaining bearing service. Particularly adaptable and popular on all remote or inaccessible installations in places where lubrication neglect is probable. One of "The Big Three", this bearing stands up on the toughest applications and is popular with the leading designing engineers. Write for valuable illustrated bulletin, without obligation.



Compo Oil-Retaining Porous Bronze

Bound Brook Cast-Phosphor Bronze



Nigrum Impregnated Hard Wood

The Bound Brook Engineering Service Department and Testing Laboratory, with a vast library of Bearing Application Data, invites correspondence with Designing and Production Engineers, particularly on problems of remote or inaccessible bearings.

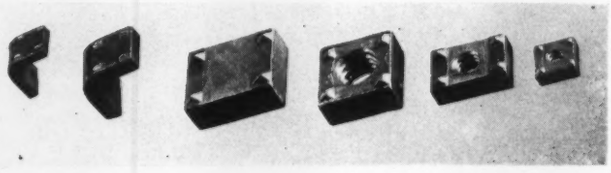
BOUND BROOK OIL-LESS BEARING CO.
(Est. 1883) Main Office and Plant: BOUND BROOK, NEW JERSEY
Sales and Service: DETROIT, MICHIGAN and LOS ANGELES, CAL.

FOR BETTER MACHINES AND APPLIANCES

mately 66 per cent lighter than steel or iron. It can be furnished in sheet, plate, rod, bar, wire, pipe, tubing, and extruded forms in a long range of gages and sizes.

Welding Fastenings Brought Out

RECTANGULAR welding nuts, rectangular welding bosses and welding brackets for application by electrical resistance welding machines have been brought out by the Ohio Nut & Bolt Co., Berea, O. The bosses and nuts are available in sizes ranging from ⅜-inch wide by 1 inch thick by ½-inch long, up



Rectangular welding nuts, welding bosses and brackets are on market for application by resistance welding

to 13/16-inch wide by ⅜-inch thick and 1 inch long. Welding brackets may have welding projections on one or both legs.

Check Valve Is Noiseless

NOISELESS check and foot valves are announced by White Machine Works, Fort Wayne, Ind. An unusual design permits unrestricted passage of a greater volume of liquid past the seat and conical poppet of synthetic rubber. The poppet is all rubber and collapsible, yet leakproof. In the foot valve, illustrated, the poppet will hold tight because of the flexible action of the rubber lips, even when held from the seat by grit or when the seat is distorted in shape. The check valve

Unrestricted passage of a greater volume of liquids is permitted by unusual design of noiseless valves

operates on the same principle but since it is made to operate in any position, horizontal or vertical, a sensitive spring has been added to close the poppet automatically. Bodies of the valves are one-piece cast red brass. These valves are recommended for use on discharge lines of pumps and air compressors where noise resulting from operation would be objectionable.

Relays Combine Sensitivity, Speed

FOR applications where a high degree of sensitivity must be combined with high speed, low-power operation, type S relays are announced by Struthers Dunn Inc., 1315 Cherry street, Philadelphia. These relays operate on only .008 watts, direct current, or .10 volt-amperes at 60 cycles alternating current, and will operate on as low as one-fourth rated power where reduced contact pressure is permissible. "Stay-put" micrometer adjustment and carefully balanced

October Brings...

MACHINE DESIGN'S

DIRECTORY of MATERIALS

(EIGHTH ANNUAL EDITION)

Readers of **MACHINE DESIGN** will be glad to know that its editors are now compiling a completely revised edition of the Directory of Materials. It will accompany the regular October issue of **MACHINE DESIGN**, as another removable, filable supplement.

Manufacturers of materials of all kinds for use in the design of machinery will again have an opportunity to place before the original specifiers of materials in this industry, full and complete information concerning their products.

The Directory of Materials is the common meeting place of specifiers and suppliers of materials for use in construction of machinery and machine parts . . . both should plan now to make the most of this annual supplement.

MACHINE DESIGN

PARTS . . . MATERIALS . . . METHODS . . . FINISHES

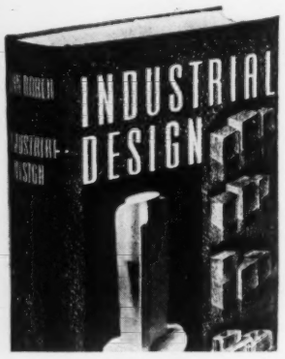
PENTON BUILDING

CLEVELAND

Here's the book you've been waiting for!

Modern industrial design fundamentals and methods

This complete, practical manual plainly covers the scope and value of appearance design, as a guide for engineers in employing it to improve their products. Step-by-step instructions are given for the complete procedure of product styling, from preliminary research to finished dimensioned drawings, including fundamentals of three-dimensional design in a form easily understood by those without previous art training.



Just Out!

INDUSTRIAL DESIGN

By Harold Van Doren of Van Doren Associates.
388 pages, fully illustrated.....$4.50

Business men and engineers will get from this book a clear picture of industrial design in all its aspects—relation to manufacturing and merchandising procedures, etc.—to help them with problems of when and how to employ it.

Especially helpful are the many practical facts on technique, including how to draw in perspective, time-saving sketching methods, making clearance models, painting clay models, use of the air brush, making and finishing presentation models, lettering, use of rubbed renderings, colored pencils, hard pastels, tempera drawings, etc.

Here is what the book gives you:

—a clear, frank explanation of the scope of industrial design as a tool of product improvement and merchandising;

—analysis of the kind of work that goes into industrial design, how to establish fees, etc.;

—instructions for carrying out design projects; how to gather data, how to approach the problem, how to make visualizations, clay models, renderings, presentation models, etc.;

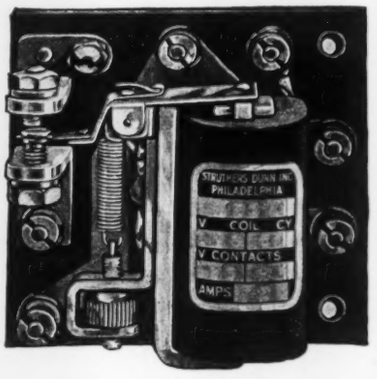
—pointers on how to present ideas to the client;

—what the designer needs to know about design patents, color technique, materials and processes of manufacture, etc.

MACHINE DESIGN

Book Department **Penton Building**
CLEVELAND, OHIO

construction of all parts are said to assure dependability, even where vibration is encountered. A special alloy core gives outstanding sensitivity and an anti-freeze pin prevents sticking of contacts caused by residual magnetism. Two types are available, one



Special alloy core gives outstanding sensitivity and anti-freeze pin prevents sticking of contacts in new relays

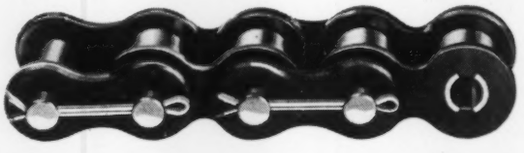
having contacts separate from the coil circuit, for general applications, the other with contacts interconnected with the coil circuit for use with contact-equipped galvanometers or sensitive mercurial thermostats.

Capacitor Motors Have Larger Ratings

EXPANSION of its line of capacitor motors for refrigeration and air conditioning service is announced by General Electric Co., Schenectady, N. Y. This line of motor, previously including ratings from ⅛ to ¾-horsepower, has been extended to include 3-horsepower.

Chain Lubricated Internally

THOROUGH internal lubrication is provided in the new roller chain developed by Howe Mfg. Co., 7500 Euclid avenue, Cleveland. It has a felt wick top and bottom between the two segmental bushings which maintains a film of oil constantly between the bushing and roller and between the bushing and pin.



Felt wick top and bottom between two segmental bushings of roller chain maintains oil film between parts

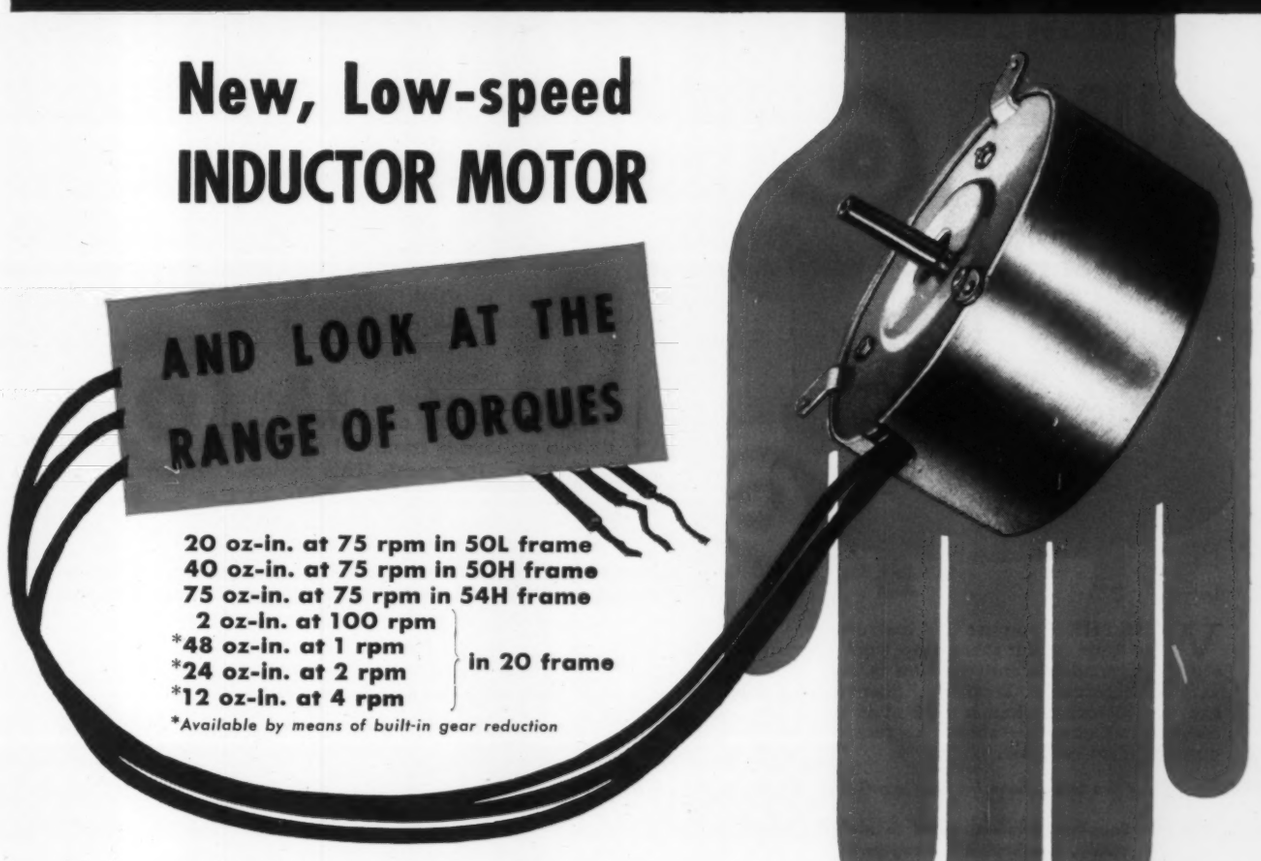
With lubrication assured, the joints are always free to articulate. This chain is standard in all dimensions and can be intercoupled with other standard roller chain.

Develop Plastic Extruded Tubing

PLASTIC extruded tubing made in continuous lengths with many useful characteristics is announced by the Irvington Varnish & Insulator Co., 24 Argyle Terrace, Irvington, N. J. Known as Irv-o-lite type XTE-30, this tubing has unusual mechanical strength, improved tear and abrasion resistance, greater solvent resistance, increased heat resistance and is more fireproof. It offers unusual flexibility, inside and outside smoothness, small wall thickness,

It's Revolutionary!

New, Low-speed INDUCTOR MOTOR


AND LOOK AT THE RANGE OF TORQUES
20 oz-in. at 75 rpm in 50L frame
40 oz-in. at 75 rpm in 50H frame
75 oz-in. at 75 rpm in 54H frame
2 oz-in. at 100 rpm
*48 oz-in. at 1 rpm
*24 oz-in. at 2 rpm
*12 oz-in. at 4 rpm
in 20 frame
*Available by means of built-in gear reduction

See Why Scores of Designers Already Acclaim This Motor—Specially Designed for Instruments and Other Applications Requiring a Low-speed Drive

Here Are Some of Its Advantages

It is small and compact enabling you to eliminate many costly parts.

It has extremely rapid acceleration and deceleration. The input to the motor is practically constant under all operating conditions. If you desire to reverse the motor, frequency of reversal has not much effect on temperature rise.

It will start all the load that it can handle when running. It is simple in construction—the rotor is the only moving part. It is quiet and efficient and does not interfere with radio reception.

Here's Where It Can Be Used

On air-conditioner controls, clocks, flashers, interval timers, oil burner controls, radio pre-timers, recording meters, signs, thermostats, time switches and other low-speed devices.

Self-starting synchronous-inductor motor, 20 frame, 2 oz-in. at 100 RPM

Here's What We Suggest You Do

If you have a job whose speed-torque requirements fall within the ratings shown above, submit complete details to the nearest G-E office for study by our application engineers, who will determine whether this motor will meet your needs. If it will, our local representative will co-operate in arranging for a trial installation. General Electric, Schenectady, N. Y.

Dept. 6A-201, General Electric, Schenectady, N. Y.

Please send me bulletin GEA-3307 describing the revolutionary new self-starting synchronous inductor motors.

Name .....

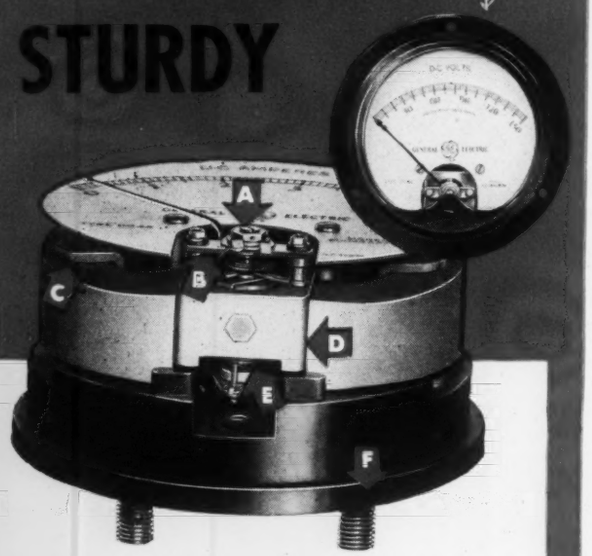
Firm .....

Address ..... *State* 700-8

City .....

GENERAL ELECTRIC

Look Inside and SEE WHY G-E Instruments Are STURDY



WHETHER you use G-E instruments yourself, or build them into your products, sturdy, dependable construction is obviously of utmost importance. Most instruments will operate satisfactorily when new. But it's long-time service that counts—ability to retain accuracy over a period of years.

That's why we build these features into G-E instruments:

A Sapphire jewels mounted in metal provide a sturdy, low-friction bearing surface.

B All parts of the instrument proper are held rigidly together by metal.

C The magnet is held securely in place by metal clamps.

D Pole pieces are die-cast together—can't change their positions regardless of severity of service

E Phosphor-bronze control springs are of finest quality and workmanship.

F Strong, molded Textolite base will not warp or change shape.

These are some of the features that help to assure you of long, accurate service even if the operating conditions are unusually severe.

G-E instruments are available in a wide variety of attractive styles and sizes for both a-c and d-c service. For complete information, call the nearest G-E Office or write General Electric, Schenectady, N. Y.

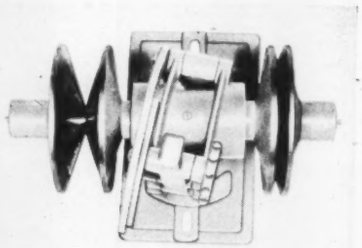
HEADQUARTERS FOR ELECTRICAL MEASUREMENT

GENERAL ELECTRIC

and will withstand soldering temperatures or other heat without flow. Now produced in five standard colors from size No. 20 to ⅝-inch, this tubing can also be furnished in different sizes and wall thicknesses.

Speed Control Has Universal Base

IMPROVEMENTS have been made in the JFS-Jr. line of variable speed controls made by Columbia Varispeed Co., 214 West Wesley, Wheaton, Ill. Long bronze bushings are now included on the center pulley halves which slide on the rotating shaft. Larger double sealed ball bearings are provided since the inclusion of the bronze bushings in the pulley halves increases the hub

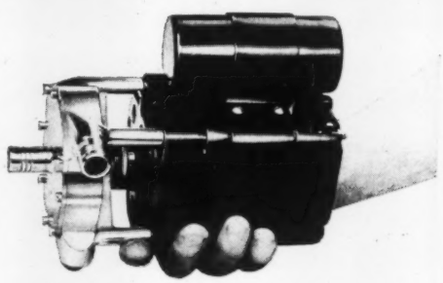


Universal base can be changed in position in improved speed control

diameters. A universal base which can be changed in position depending on the relationship of the driving and driven pulleys is mounted on a sub base at right angles to the rotating shaft. This makes the mounting of the JFS-Jr. unusually easy without sacrificing the flexibility of the original design of the base.

Midget Pump Handles Thin Liquids

FOR industrial, pilot plant, laboratory and experimental applications where thin liquids are to be handled and when space, weight and portability are factors, a new midget centrifugal pump is announced by Eastern Engineering Co., 45 Fox street, New Haven, Conn. Total internal volume is 50 cubic centimeters. Coupling is unnecessary and perfect alignment is assured because the motor armature and pump impeller are mounted on a single shaft. Maximum pressure is 17 pounds per square inch; maximum volume, 5 gallons per minute. Weighing 14 pounds, the pump has a split capacitor type motor without mechanical contact between field and rotor except two shaft bearings.



Midget centrifugal pump is useful for applications where thin liquids are handled

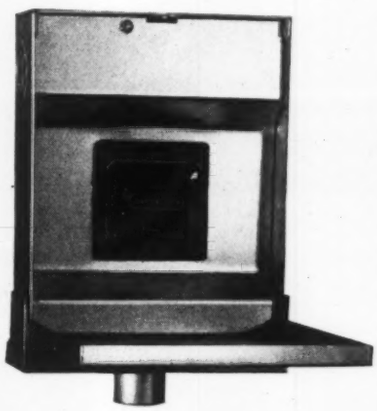
Develop Pressure Gage-Valve

FOR receiving a varying or high air pressure at the inlet side and automatically delivering a constant reduced pressure at the outlet side, a combination pressure gage and self-contained reducing regulator valve has been introduced by the Dayton Rogers Mfg. Co., Minneapolis. It is primarily designed for all air pressure control. This type is especially desirable for installation in limited space. A safety release valve

releases any excessive pressure. The filter is the replaceable cartridge type and can be removed without use of special tools or without dismantling or dismounting the regulator. Three extra regulator seats are furnished in a compartment on the adjusting screw. Each regulator and gage is provided with a mounting bracket, together with vibration dampeners to relieve any machine shock.

Changes Made in Switch

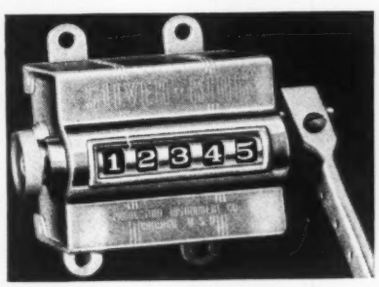
IMPORTANT design changes in its outdoor 60-ampere switch using the Square-D fuse-break, No. 39902, are announced by the Square D Co., Detroit. Base of the switch is strong, light weight plastic, and plastic pullout has "on" and "off" positions clearly indicated. Soldering connectors are used throughout. The enclosure is galvanized steel, with aluminum finish. Cover may be sealed or padlocked. The switch can be furnished with or without conduit hubs and nipples and there is an ample supply of knockouts below the live parts of the switch.



Base of redesigned switch using fuse-break is plastic and soldering connectors are used throughout

Mechanical Counter Is Sturdy

NAMED the Silver King, a mechanical counter has been developed by Production Instrument Co., 702-08 West Jackson boulevard, Chicago. Heavy number wheels are replaced by Bakelite—reducing by 85 per cent the weight that must be started and stopped with every count. The steel base and cover are permanent and sturdy. First model on test counted at 60,000 per hour and on long runs at 36,000 per hour.



Heavy number wheels in new mechanical counter have been replaced by plastics, reducing weight to be moved 85 per cent

Electronic Switch on Market

NEW pilot control announced by Photoswitch Inc., 21 Chestnut street, Cambridge, Mass., is an electronic switch making possible control of large currents by delicate mechanisms, liquids, or extremely light

2 NEW LIMIT SWITCHES

This switch has double-break, fine-silver contacts for long life.

LEVER-TYPE ONLY $6.00

Modern design of enclosure presents attractive appearance.
Simple mechanism has minimum number of parts.
Adjustable lever easily shifted to any operating position.
Strong noncorrodible, die-cast enclosure protects mechanism.

Note the strong, dust-proof noncorrodible die-cast case. Double-break, fine-silver contacts open and close with a rocking motion.

GEAR-TYPE ONLY $16.00

Mechanism easily adjusted from ½ turn to 120 turns.
Liberal overtravel prevents accidental damage to mechanism.
Contact at each end of travel can be normally open or closed.

Each of these switches is the leader in its field. Compare them, point-by-point, with the switches you are using. We'll be glad to send you literature describing them in detail. Just fill in the coupon below.

General Electric, Sect. B 676-11
Schenectady, N. Y.
Please send me publication GEA-2502 describing your new general-purpose limit switches.
Name .....
Address ..... State .....
City .....
676-11

SOLD, to Date:

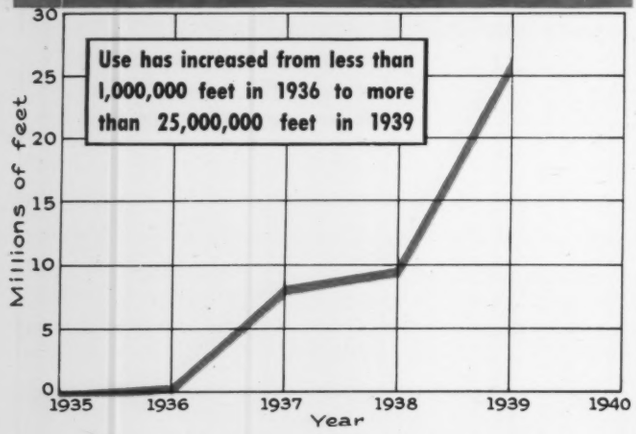
45,000,000

Feet Of

FLAMENOL

REG. U. S. PAT. OFF.

WIRE

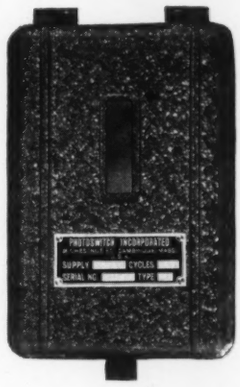


AT the end of last year, sales of Flamenol wire and cable had reached the total of 45,000,000 feet. Factory costs have gone down, and the savings have been passed on to customers in the form of new low prices. Ask for our price sheet.

This widespread acceptance of Flamenol is evidence of its ability to resist flame, oils, acids, alkalies, and moisture. For *any* low-voltage wiring that has been giving you trouble, Flamenol is the answer. Have you checked the new Underwriters' listings? They may contain tips on new profitable uses. See Bulletin GEA-2733. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

contact pressure normally incapable of being used to control electric currents. Control is effected by the delicate touching of two fine wires or contacts, or by



Large currents may be controlled easily by delicate mechanisms through use of electronic switch

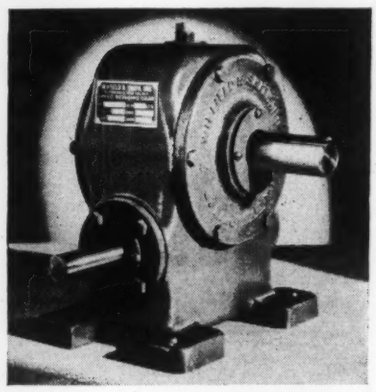
their being short-circuited by a liquid or any moist material. Only three-millionths of an ampere may in this way control any current desired.

Oilers Furnished on Motors

EXPLOSION proof motors for Class I, group D and double-enclosed motors, equipped with oil lubricated ball bearings and constant level oilers, are announced by U. S. Electrical Motors Inc., Los Angeles. They are furnished as standard on all 3600 revolutions per minute ratings and on all 1800 revolutions per minute ratings larger than 25-horsepower.

Worm Is Integral with Reducer Shaft

ESPECIALLY selected steel is used for the form in No. 4½B worm gear speed reducer announced by Winfield H. Smith Inc., Springville, Erie county, N. Y. The worm is integral with the shaft and hardened and ground all over, including the worm threads. The gear



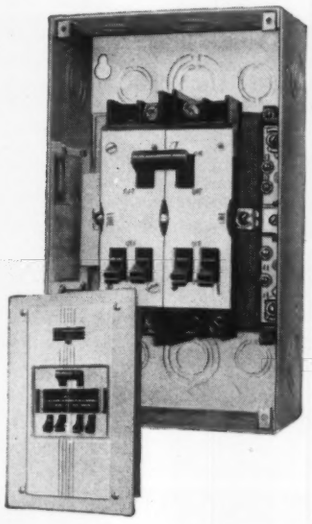
Worm is integral with shaft in worm gear speed reducer, and hardened and ground all over, including threads

is high grade alloy bronze. Ratings range from ¼ to 2-horsepower, with torque capacities from 567 inch-pounds at 60 to 1 ratio to 1095 inch-pounds in lower ratios. Oil seals are built-in on both worm and gear shafts.

Multi-Breaker Has Grounded Case

CHANGE in the case construction as used with type MB multi-breaker assemblies is announced by Cutler-Hammer Inc., Milwaukee. The device now has an insulated groundable neutral combining the construction of the insulated and grounded neutral. Simply inserting a screw in a tapped hole of the

insulated neutral bar grounds the neutral and the case. These assemblies are available with from one to 16 breakers which can be arranged for 2 or 3 pole



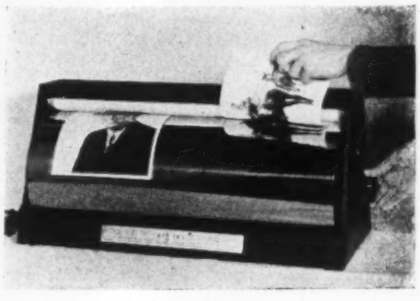
Improved multi-breaker has insulated groundable neutral and other changes in case construction

solid neutral circuits for alternating current service. Like the company's other multi-breakers, type MB is furnished in either flush or surface mounting types.

Engineering Dept. Equipment

Announce Rotary Print Dryer

A ROTARY print dryer for drying photostatic and photographic prints, blueprints, and other wet-developed prints, is announced by Warren Electric Appliance Co., Warren, Pa. It has chromium plated drum which will take either matte or glossy prints up to 24 by 28 inches. Prints are placed on the electrically heated drum which is revolved by a handle, pulling a



Either matte or glossy prints up to 24 by 28 inches can be handled by rotary print dryer

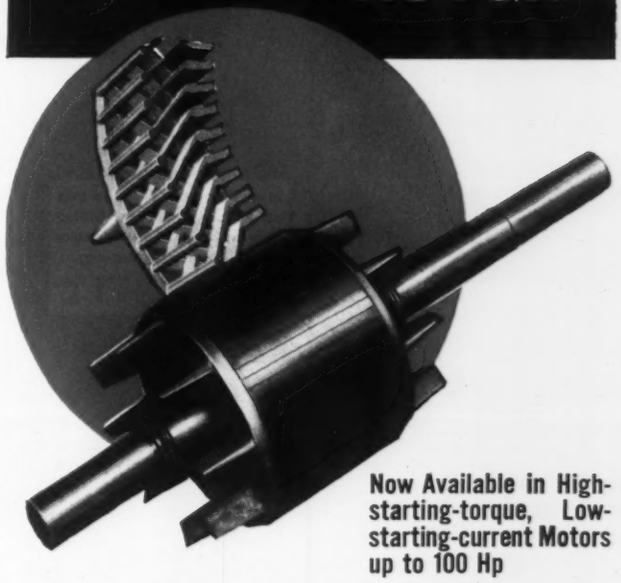
canvas belt over the prints so that they dry flat and even in four to eight minutes. The Senior-Commercial model illustrated uses 230 watts, alternating or direct current. A smaller model with 12-inch wide drum is also available.

Fluorescent Fixtures on Market

TWO fluorescent lighting fixtures are announced by Van Dyke Industries, 2857 South Halsted street, Chicago. The No. 1275 clamp-on drafting board light is adjustable in height and the shade makes only one complete revolution, to prevent twisting of wires. It is supplied for either 15 or 20 watt fluorescent tubes, and comes in two lengths of arm extension. The No. 5001-A is an adjustable arm fluorescent drafting board fixture, with an arm that can be applied to different clamps.

For Your High-Starting-Torque Job!

THE CAST-ALUMINUM *Valv-amp* ROTOR



Now Available in High-starting-torque, Low-starting-current Motors up to 100 Hp

THIS is the first fundamental development in double squirrel-cage rotors since their invention 40 years ago. Now you can have cast-aluminum rotors in low-starting current, high-starting-torque motors up to 100 hp.

The Valv-amp is finding ready acceptance for installations where high starting torque must be obtained under conditions imposing limitations of starting current. With the Valv-amp you get all the advantages of a cast-aluminum winding—electrical permanence, rapid dissipation of heat losses during starting (because bars, end-rings, and fans are cast integrally), and freedom from loose bars and high-resistance hot spots (because the entire rotor winding is a single homogeneous unit).

APPLICATIONS

For high-starting-torque, low-starting-current jobs such as: driving loaded conveyors, commercial refrigeration and air-conditioning compressors, and ball mills.

Call the nearest G-E Office, or write General Electric Co., Schenectady, N. Y., for complete information on Valv-amp.

SEE THE G-E "HOUSE OF MAGIC" AT BOTH FAIRS

GENERAL ELECTRIC

. . . Where Maximum Production Depends on a Reliable Coolant Supply — Use a Brown & Sharpe Centrifugal

BS
Investigate the many features of Brown & Sharpe Motor Driven Centrifugal Pumps. Write for Pump Catalog.
Brown & Sharpe Mfg. Co.
Providence, R. I., U. S. A.

BROWN & SHARPE PUMPS

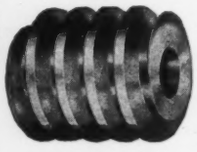
"ONLY BY MAKING *Precision Gears* HAVE WE PROGRESSED"

WINFIELD H. SMITH

We have been making them since 1901 . . . 39 years . . . and we now sell more than ever.

★ ★ ★

One important reason for the superlative ACCURACY of WHS worms, worm gears, spurs and helical gears is that only the *very finest precision workmanship* goes into the gears we make for WHS Speed Reducers . . . . and this same skill and care characterizes ALL the gears we manufacture. They are hardened and heat-treated right in our own plant.



Let us quote on your gear requirements! Especially attractive prices offered on semi-production runs of a single size.

WINFIELD H. SMITH, Inc.

A Speed Reducer for Every Application

16 ELTON STREET, SPRINGVILLE, ERIE COUNTY, N.Y.

Meetings and Expositions

July 30-Aug. 1—

National Piano Manufacturers Association of America. Annual meeting and exhibition to be held at Stevens hotel, Chicago. W. A. Mennie, 45 West Forty-fifth street, New York, is secretary.

Aug. 19-23—

National Association of Power Engineers. Annual meeting to be held at the Deshler-Wallick hotel, Columbus, O. Fred W. Raven is secretary, 176 West Adams street, Chicago.

Aug. 26-30—

American Institute of Electrical Engineers. Annual meeting to be held at Ambassador hotel, Los Angeles. H. H. Henline, 33 West Thrity-ninth street, New York, is secretary.

Sept. 3-6—

American Society of Mechanical Engineers. Fall meeting to be held at Spokane, Wash. C. E. Davies, 29 West Thirty-ninth street, New York, is secretary.

Sept. 10—

National Association of Ice Refrigerator Manufacturers. Annual meeting to be held at Sherman hotel, Chicago. H. L. Covert, 310½ Broadway, Abilene, Kansas, is secretary.

Sept. 15-21—

Twenty-fourth Annual Eastern States exposition to be held in Springfield, Mass. Additional information may be obtained from J. H. Fifield, Eastern States Exposition, Springfield, Mass.

Sept. 16-19—

American Mining Congress. Annual metal mining convention and exposition to be held at Colorado Springs. Julian D. Conover, 309 Munsey building, Washington, D. C., is secretary.

Sept. 18-20—

National Industrial Advertisers association. Annual meeting to be held at the Hotel Statler, Detroit. Miss M. R. Webster is headquarters secretary, 100 East Ohio street, Chicago.

Sept. 24-27—

Association of Iron and Steel Engineers. Annual meeting to be held at the Stevens hotel, Chicago. Brent Wiley, 1010 Empire building, Pittsburgh, is managing director.

Oct. 12-19—

National Dairy association. Meeting and exposition to be held at Harrisburg. Lloyd Burlingham, 308 West Washington street, Chicago, is secretary.

Oct. 16-18—

Porcelain Enamel institute. Annual meeting to be held at University of Illinois, Urbana. C. S. Pearce is secretary, 612 North Michigan avenue, Chicago.

Oct. 17-23—

Wire Association. Annual meeting and exhibition to be held at Carter hotel, Cleveland. Richard Evan Brown, 300 Main street, Rooms 609-13, Stamford, Conn., is secretary.

Oct. 20-25—

American Welding Society. Annual meeting and exposition to be held at Hotel Cleveland, Cleveland. Miss M. M. Kelly, 807 Riverside Drive, New York, is secretary.

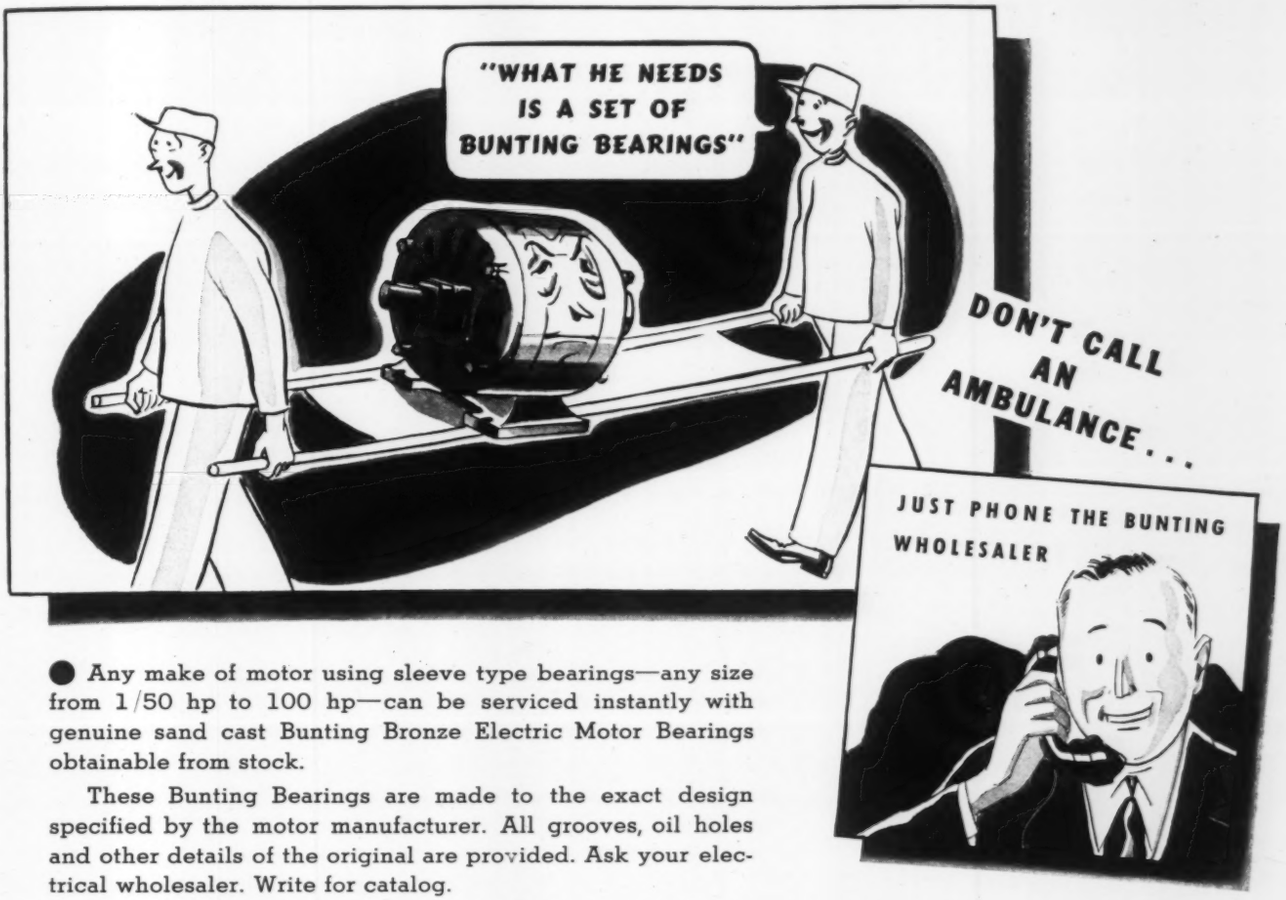
Oct. 21-25—

American Society for Metals. Annual meeting to be held at the Hotel Statler, Cleveland. W. H. Eisenman is secretary, 7016 Euclid avenue, Cleveland.

Oct. 21-25—

National Metal Congress and Exposition to be held at Public Auditorium, Cleveland. W. H. Eisenman, 7016 Euclid avenue, Cleveland, is secretary.

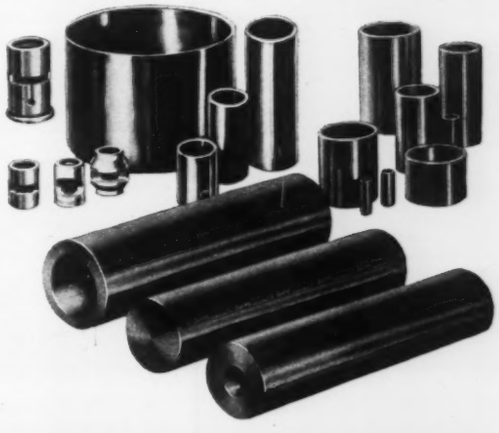
FIRST AID FOR ELECTRIC MOTORS



● Any make of motor using sleeve type bearings—any size from 1/50 hp to 100 hp—can be serviced instantly with genuine sand cast Bunting Bronze Electric Motor Bearings obtainable from stock.

These Bunting Bearings are made to the exact design specified by the motor manufacturer. All grooves, oil holes and other details of the original are provided. Ask your electrical wholesaler. Write for catalog.

Completely finished bearings for production and maintenance of industrial machinery are also available from stock in hundreds of sizes, as are Tubular and Solid Bearing Bronze Bars. Your wholesaler can supply you . . . The Bunting Brass & Bronze Company, Toledo, Ohio. Warehouses in All Principal Cities.



Made To Blueprint

Our Product Engineering department offers free of cost a consulting technical service of immense value when bearing specifications are being drawn. Let us quote on your special requirements.

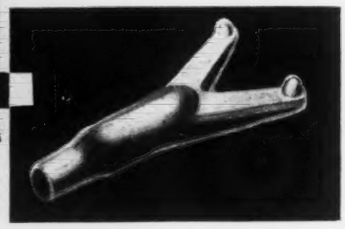
BUNTING

BRONZE BUSHINGS
PRECISION BRONZE BARS

Bunting

BEARINGS
BABBITT METALS

64



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LARGEST EXCLUSIVE BUILDERS OF COOLANT PUMPS

Mechanism Improved, Size Reduced

(*Concluded from Page* 33)

sudden vibration causes the recorder to leave the counterweight whereupon the natural frequency of the system is changed and the vibration is damped out at the start. Other features of this new recorder include improvements in the articulated member serving as a connection to the speaking tube to provide a uniform and unobstructed sound passage, and a lighter and yet more rigid mounting of the recording stylus. This little holder weighs only 95 milligrams.

Automatic motor switch which is started when the dictator picks up the speaking tube to dictate and shut off when the speaking tube is returned to its hook has long been a familiar feature of these machines. It is shown in *Fig.* 6. The comparatively light weight of the speaking tube operates the switch and for many years, a direct make and break mechanism was used with considerable success. Stricter electrical requirements, providing against possible continued arcing of the switch, resulted in the insertion of a toggle mechanism to make and break the contact quickly and positively. In designing the new model, it was determined that requirements of compactness would justify the employment of a mercury type switch, permitting reduction of the size of the unit and at the same time simplifying the operating linkage. It is anticipated the advantages of this switch will warrant the increased cost. Since the flash from the operation of the switch would be visible through the louvres in the machine base, the glass tube is coated with black paint to prevent any possible annoyance from this cause.

Parts Merged Harmoniously

In general, it is notable that all parts of the machine have been merged into a harmonious whole. Sizes and shapes of levers and other external parts are designed to express at once their function and their relationship to each other. As a good example of the methods employed in designing some of these parts, the speaking tube presented the problem either of being modernized in appearance so that it blended with the rest of the unit, or of being removable and thus eliminated to a certain extent as a styling problem. After the former course was chosen, the mechanical design of the tube was left unchanged but at the point of juncture with the machine two readily removable diecast covers were found desirable to aid efficiency and appearance. One of these covers, when first produced, was the thinnest section diecasting made, side walls being .025-inch thick.

The upper end of the speaking tube and the detachable mouthpiece required a search for the best combination of esthetic values and adaptability to the human physiognomy. Because the resulting shape was so irregular in contour a molded or cast part was indicated, finally being molded of Tenite colored to match the standard Dictaphone taupe finish.

COMPACT
Figure 5173—Hydro-Power Gear Pump flange—mounted directly to end of motor with close-coupled shaft connections.

CONTINUOUS SERVICE under strenuous operating conditions is assured with . . . .

HYDRO-POWER GEAR PUMPS

due to long Tapered Roller Bearing Construction and revolutionary design. Pressure capacity up to 1000 pounds per square inch.

Let Hydro-Power Engineers tell you how you can do a superior hydraulic pressure control job with modern Hydro-Power Gear Pumps.

INDEPENDENT
Figure 5339—Hydro-Power Gear Pump with foot mounting for direct connection to motor shaft through flexible coupling

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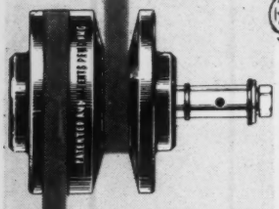

The Speedmaster is mounted between the driving and driven pulleys, a belt running from each to the Speedmaster. As the Speedmaster is moved closer to one and farther from the other, one belt is forced farther into the unit and the other allowed to ride out. The sliding center block compensates for this, maintaining belt tension. The pulley assembly floats on its shaft, keeping the belts always in line.

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SPEEDMASTER

VARIABLE SPEED PULLEYS

WIDE RANGE . . . SIMPLICITY . . . LOW COST

Photography "Stops" High Speed Motions

(*Concluded from Page* 39)

at a distance of two to three feet, the lens can be stopped to *f*16 or *f*22. With two lamps at 4 to 5 feet, *f*11 is satisfactory, and if one lamp is placed 3 to 4 feet from the object, *f*5.6 to *f*8 will give good results. Where multi-flash exposures are made on a single negative with one lamp at a distance of two feet from the object, the lens should be opened to *f*4.5 provided the number of exposures is not more than ten.

When the number of exposures is increased, the lens must be stopped down. For instance, if 100 exposures are to appear on the negative, the lens opening should be adjusted to *f*6.3. This decrease in the amount of lens opening is necessary because the repeated exposure of the film eats through the emulsion and destroys the contrast. If a black disk with a white line on it is photographed by the multi-exposure method and the lens opening is too wide, the background will be so light that the various positions of the white line cannot be determined accurately.

Camera shutters are important. The quick action of the Compur shutter makes it preferable to a focal plane shutter. In the Compur shutter there is no time lag when it is being operated on "bulb." With it the operator can synchronize the opening of the shutter with the operation of the stroboscope.

Choice of Film Important

Choice of film is a matter that merits consideration. Many high grade, high speed films of the orthochromatic or the panchromatic type are available. A film like Eastman's Super XX developed in Eastman's DK-60A developer gives clear and brilliant negatives when exposed under the conditions previously outlined. This combination enables the exposure to be made with a relatively small lens opening and the film to be developed in a relatively short time with a minimum of grain structure. Doubtless, other combinations of film and developer will give similar results.

For special problems a method of taking ultra slow-motion pictures has been developed. The camera has no shutter and film is driven continuously by a motor, the speed of which can be set as desired. A commutator on the sprocket which drives the film causes a large stroboscope to flash at intervals which coincide with the frame divisions in the conventional 35 millimeter motion picture film. With this apparatus, ultra slow-motion pictures can be made at speeds up to 6,000 frames per second.

This type of equipment is best adapted for studies where a single observation per machine cycle is not sufficient, or where multiple exposures on a single negative are confusing. It enables a continuous series of pictures to be taken of a single cycle of machine operation. It accomplishes the same results as moving picture cameras but permits greater magnification of time than is possible with other cameras that are available.

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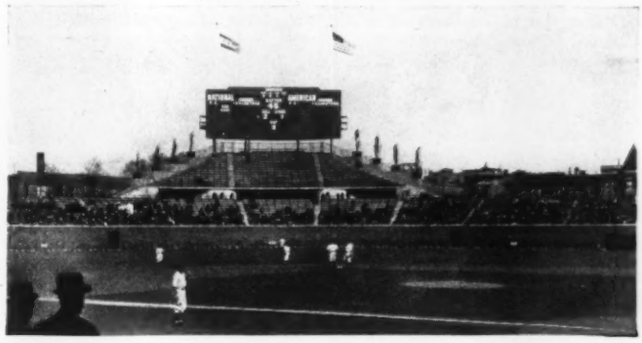

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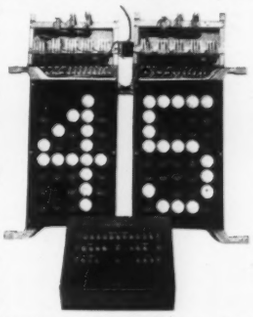

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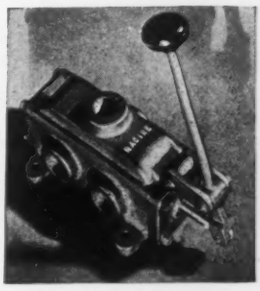

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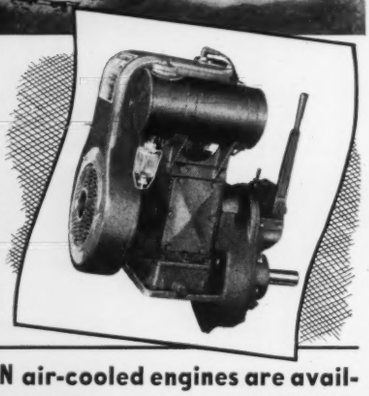

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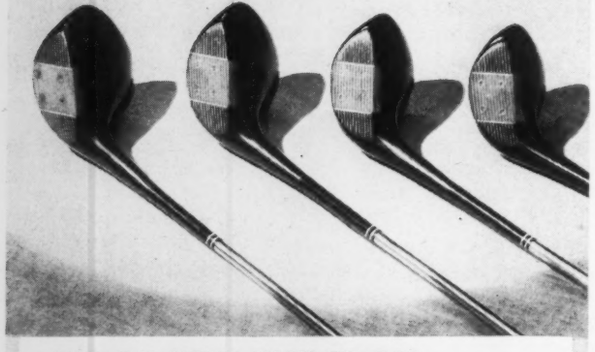

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This is one application of many thousands, where the properties of G-E Textolite laminated have met a special need. Possibly we can be of help to your Engineering Department. Write Section I-70, Plastics Department, General Electric Company, One Plastics Avenue, Pittsfield, Mass.

GENERAL ELECTRIC

How To Utilize Rubber Under Compression

(*Continued from Page* 53)

ered as influencing the effects of natural frequency and resonance conditions. In fact, the hysteresis property is an excellent tool for the designer to work with in minimizing the all too frequent occurrence of resonant vibrations. Sections V, VI, and VII in the appended list have been provided to facilitate such work.

Constituents of rubber compounds can be varied to change appreciably the hysteresis effect. Since changes in compounds probably affect other properties, it is essential, at least for the present, that the designer and the rubber compounder work closely together.

Co-operation is especially important in the evolution of rubber parts which are to be subjected to deflections under service conditions of such continuous or rapid nature that the hysteresis effect results in excessive temperatures within the rubber part. Typical examples of the hysteresis effect under 50 per cent deformation and 60 inches per minute rate of load application are shown in *Fig.* 6. Values for the damping factor, an expression for hysteresis, are shown in Table I.

TABLE I

Average Values of Physical Properties of Rubber Compounds Applicable to Design

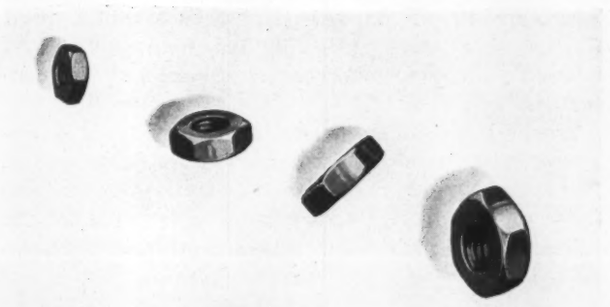
Property	Compound-durometer					
	30	40	50	60	70	80
Specific weight (lbs./cu. in.)	.036	.038	.040	.043	.045	.047
Specific heat BTU/lb./°Fahr. ...	.46	.43	.40	.38	.35	.33
Thermal conductivity BTU/sq. in./min./° Fahr./in. thickness	.00011	.00012	.00012	.00013	.00014	.00015
Thermal expansion Vol. ration/°Fahr..	.00033	.00029	.00026	.00024	.00022	.00020
Shrinkage—% linear from the as molded condition to atmospheric 24 hrs. after vulcanization	2.1	2.0	1.8	1.5	1.3	1.1
Damping ratio* D...	.014	.016	.037	.074	.12	....
Hysteresis ratio* D_1.	.16	.18	.40	.61	.77	....
Compressibility	Less than .0004% per lb. applied Load per sq. in. area					

* See *Fig.* 6 for values obtained with specific test conditions.

CREEP: The engineer's interest is primarily in the dimensions of the rubber part as it is loaded in his design. Since "creep" gives change in deformation directly, it is more useful in design work than "permanent set."

After vulcanization, rubber undergoes a transient change in deformation properties dependent upon the extent and time of previous load applications. This property is expressed as creep. Significance of this property to the designer lies in the fact that the first several cycles of load application cause an appreciable change in effective length, after which further creep is small.

This transient change resulting from successive load application is shown in *Fig.* 7 for a typical rub-



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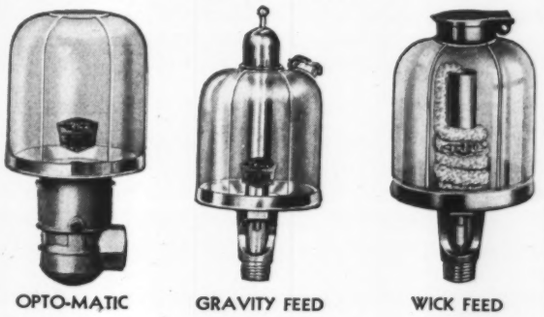

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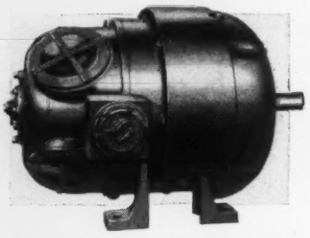

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ber compound. From this it may be concluded that at least three, and preferably ten, load applications should be made before any performance tests are conducted.

Creep should be determined by actual test. It increases with increased load and diminishes with time. The following per cent change in initial deformation figures approximates values to be anticipated for the indicated static loads and time intervals at temperatures not exceeding 100 degrees Fahr.

Compound Hardness (durometer)	Load (lbs./sq. in.)	—Change in Deformation— 24 hours (per cent)	1 year (per cent)
30	35	2	12
40	75	4	25
50	100	8	35

NOISE ABSORPTION: Noise may be pictured as a special case of vibration having frequencies in the audible range (1800—600,000 cycles per minute). The extremely minute displacements (less than .0001-inch) and high frequencies may be treated dynamically similar to other vibrations.

Since displacements are much smaller than the thickness of the usual elastic noise isolating part, the part does not deform as a whole, as is the case when such part is subjected to low frequency vibrations. Instead, noise vibrations cause a load deformation equal to only a small fraction of the thickness of the elastic part, and the weight per cubic inch of the part serves as the load which the vibration causes to move. Thus, a series of deflections are continuously passing through the part. The resistance which the material develops to such flow of vibrations determines the noise absorption properties of the elastic material.

Stiffness Factor Must Be Small

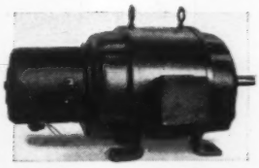
Velocity of sound in a material is given in the appended list, section IX. For 30 durometer rubber compounds with loads to 50 pounds per square inch, the velocity is 98,000 inches per minute. For 70 durometer with loads of 600 pounds per square inch, the velocity increases to 397,000 inches per minute. These facts indicate that the stiffness factor S_1 must be made as small as possible if the design is to have the best noise isolation properties. This can be done (*Figs.* 1 and 2) by using thicker and softer rubber parts with low loading per square inch.

The remarkable ability of rubber compounds to deform elastically and to flow plastically causes the designer to neglect taking precautions to distribute stresses. Care ordinarily used with metals in corner radii, edges, change in section, and the like, will be found well worth while in securing improved serviceability with rubber compounds. As in all molded material, part design should be carefully correlated with mold design. It is seldom indeed that an initial part design cannot be changed in some minor detail to improve performance or lower cost.

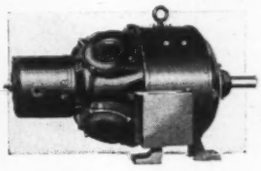
No easy road to a complete solution of the rubber parts application problem is available. Progress to date has resulted with better understanding and use of a more common terminology, elimination of non-essential design and specification detail and reduction to practice of some of the wealth of fundamental information now available.

Disc-Brake

RELIANCE 4C DC MOTORS



Squirrel-cage Splash-proof Reliance Motor with integral magnetic brake



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Use these combined units — For power applications requiring quick, accurate, automatic stops or the holding of a load . . . Clutches can often be eliminated and the motor direct connected . . . Dimensions meet N. E. M. A. Standards . . . The brake is a compact, disc-type friction device, mechanically and automatically engaged when current is shut off, and magnetically disengaged when current is applied . . . Easy to adjust; parts are readily accessible . . . Typical applications are small cranes, hoists and auxiliary movements on machine tools.

Details are found in Bulletin 305

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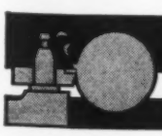

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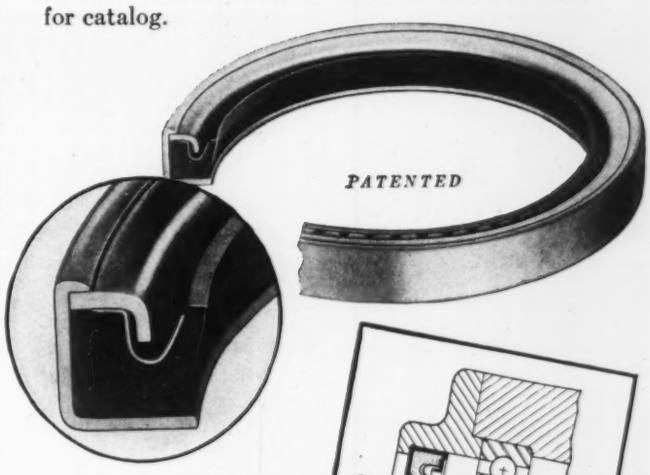
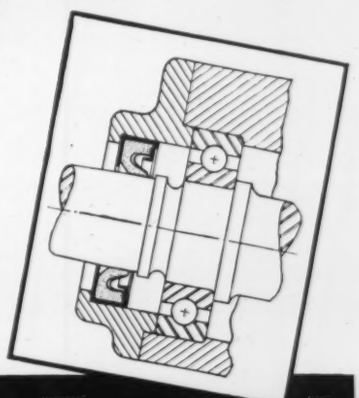
LATROBE, PENNSYLVANIA, U.S.A.

Made of an exclusive Garlock compound, the sealing ring of the Garlock KLOZURE Oil Seal resists oil and water at high or low temperatures. Friction is reduced to a minimum. You can depend on this Oil Seal to give you superior performance under the most severe conditions. All sizes. Write for catalog.





THE GARLOCK PACKING COMPANY
PALMYRA, N. Y.

In Canada: The Garlock Packing Co. of Canada Ltd. Montreal, Que.

GARLOCK

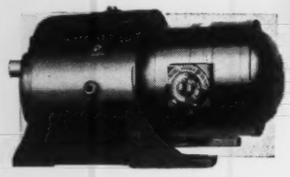
Space-Saving

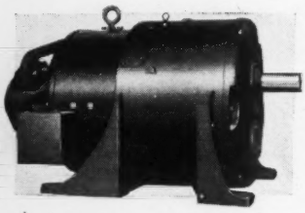
RELIANCE A-C. ★ D-C. GEARMOTORS

These efficient, space-saving units, combining motor and speed reducer, keep down installation costs and maintenance . . . Simplicity of the Reliance design facilitates taking apart and assembling . . . Wide range of ratios for a-c. and d-c. . . . Constant-speed, multi-speed, adjustable-speed types . . . Open, splash-proof, fan-cooled and explosion-proof designs.

Get Bulletins 403 and 404 for details.

Explosion-proof, Fan-cooled A-c. Gearmotor. Approved for use in hazardous locations. ↓





↑ Adjustable-speed D-c. Reliance Gearmotor, double reduction.

Reliance Electric & Engineering Co.

1079 Ivanhoe Road Cleveland, Ohio

Branches and Representatives in Principal Cities

REDUCE THE HUMAN ELEMENT

TH' ROOSTER THINKS IT'S SUNRISE, POODY 'CAUSE "NUTTY" GOT TIRED A'FORE FANNIN' OUT THE LIGHT!

***WITH* VICTOR MOTORS!**

If air conditioning units were made to be pampered — but why suppose? They're not. The demand is for a unit that will blow hot or cold 24 hours a day and never stop 'til the cows come home. Any good unit can answer this demand if it operates on a super-powered shaded-pole induction type Victor Motor. A motor that lends itself to complete speed control. A motor whose oversized oil-impregnated self-aligning bearings portion out oil in just right quantities — never too much — never too little. There is a rugged dependable Victor Motor for any device within the range of 1/200 to 1/10 H.P. The Victor engineers love to tackle tough motor problems. Let's get started on yours. Write today and tell us your troubles.

Dept. M-304

Typical Applications of Model Illustated

Air conditioners (Winter or summer) - Evaporative coolers - Auxiliary blowers and fans - Cabinet Heater Circulators - Cold air return boosters - Warm air pipe boosters - Window ventilators - Auxiliary draft blowers for oil burners, gas burners, and stokers.

VICTOR ELECTRIC PRODUCTS, Inc.

2950 Robertson Road . . . Cincinnati, Ohio

Business and Sales Briefs

MOVING of its general offices from Elizabeth, N. J., to its new plant at 2332 Vauxhall road, Union, N. J., a suburb of Newark, is announced by Elastic Stop Nut Corp. Built by the Austin Co., the new plant will be used exclusively for the manufacture of Elastic Stop self-locking nuts. It is announced also that the corporation's Houston, Tex., office has been moved to the Merchants and Manufacturers building.

♦

J. S. Bennett has been appointed manager of sales for the American Engineering Co., Philadelphia.

♦

John W. Murphy has been promoted to assistant manager of sales, Baltimore district, Bethlehem Steel Co.

♦

Appointment of G. L. Crawford as Buffalo district manager in charge of sales, Wickwire Spencer Steel Co., New York, is announced. He succeeds A. G. Bussmann, recently made general sales manager.

♦

Julian d'Este Co., Boston, has been merged with American Chain & Cable Co. Inc., Bridgeport, Conn., and its products will be manufactured in the latter's plant at Reading, Pa. These parts include pressure reducing, tank and float, and relief valves, liquid temperature, hot water tank and pump regulators.

♦

Universal Gear Corp., Indianapolis, announces the appointment of M. E. Robbins of the New York district sales office as assistant director of sales, in direct supervision of all eastern sales. His headquarters will be in the Lincoln building, 60 East Forty-second street, New York.

♦

O. P. Robinson has been appointed to the Pittsburgh sales staff of Cutler-Hammer Inc., Milwaukee. An electrical engineering graduate of Armour Institute of Technology, Mr. Robinson was formerly in the company's Chicago office. Cutler-Hammer also announces removal of its Minneapolis office and warehouse to larger quarters at 532 South Seventh street. Horace H. Ratcliff, Clyde A. Russ and Donald Ladwig represent the company in the Minneapolis territory. The Cutler-Hammer office and warehouse in Atlanta, Ga., has moved to 134 Marietta street Northwest, with A. C. Gibson in charge.

♦

Linde Air Products Co., a unit of Union Carbide & Carbon Corp., New York, announces the election of T. D. Cartledge and L. A. Bliss as vice presidents and of E. J. Hayden as vice president, Central division. E. B. Suydam has been appointed general sales manager to succeed Mr. Cartledge and P. B. Pew has been appointed works manager to succeed Mr. Bliss. Mr. Hayden was formerly manager of the Central division.

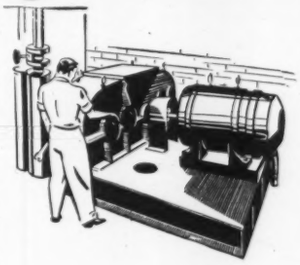
♦

Fred L. Lawrence has been appointed Detroit district manager for the Copperweld Steel Co., Warren, O. Offices are in 7-251 General Motors building, Detroit. Mr. Lawrence attended the University of Michigan and was formerly connected with the Frost Gear and Forge Co., as chief metallurgist, Pittsburgh Crucible Steel Co., Midland, Pa., as senior metallurgist, and later

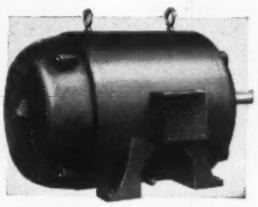
Enclosed, Fan Cooled

RELIANCE A-C D-C MOTORS

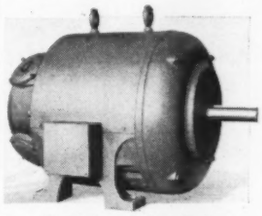
Where motors are exposed to dirt, iron dust, oil, and moisture these protected motors require less attention and show better records for steady operation. Windings stay clean and air gaps clear. They provide low-cost insurance against lost production and excessive maintenance . . . Motors are interchangeable in all mounting dimensions in most cases with standard open motors of the same rating.



For details get Bulletins No. 120 (A-c.) and No. 214 (D-c.)



Type AA, Enclosed, Fan-cooled Reliance Induction Motor



Type T, Enclosed D-c. Reliance Motor for constant and adjustable-speed service

Reliance Electric & Engineering Co.

1079 Ivanhoe Road **Cleveland, Ohio**

Branches and Representatives in Principal Cities

1431 NATIONALLY KNOWN MANUFACTURERS USE *AMPCO METAL* FOR DIFFICULT SERVICES . . .

***—Let's* LOOK INTO IT FOR OUR PRODUCTS**

THE increasing preference for Ampco Metal for highly stressed service parts is convincing evidence of its inherent superiority over most non-ferrous alloys. . . . Time and again, Ampco Metal has proved its extraordinary wear resistance—its strength and shock-proof qualities—its ability to often outwear hardened steel—in applications including gears, bushings, bearings, nuts, cams, shifters, thrustplates, forming and drawing dies.

You probably have a place for Ampco Metal in one or more of your products. Why not check with us.

Send for data on Ampco Metal and its uses in modern industry.

AMPCO METAL, INC.

Dept. MD-7 **Milwaukee, Wisconsin**

The Correct Nut

FOR EACH FASTENING PROBLEM

. . . . and every one embodying the Elastic Stop Locking Element

More than 700 types and sizes of Elastic Stop Nuts are now available . . . every unit made self-locking with a resilient non-metallic collar that holds nut and bolt threads in constant pressure-contact.

These nuts do not work loose under vibration, hard service, or wear of surrounding parts. And they retain their full locking effectiveness when used over and over again. **Try them on your troublesome fastening jobs.**

←Write for this 56-page Catalog

ELASTIC STOP NUT CORPORATION

2326 VAUXHALL ROAD · UNION, NEW JERSEY

Elastic Stop SELF-LOCKING NUTS

AMPCO METAL

The Metal Without An Equal

AMPCO

SPIRAL GEARING

— in the finer pitches 14 to 96 D. P.

Also **SPURS — BEVELS — WORM GEARING**

Your small Gear needs may be few or many—experimental or production—'fussy' or 'commercial'—intricate or simple—Whatever they are, consult SPECIALISTS such as—

Made to order only—No stock—No catalog

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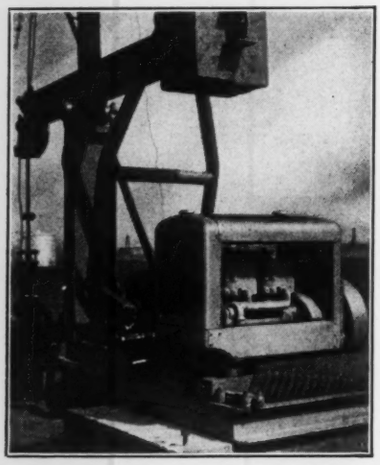
2670 W. MEDILL AVE. Phone Humboldt 3482

CHICAGO

Make Yours a NOVO Engine they can STAND THE GAFF!



You are entitled to the same rugged dependability in the power units that you use as is demanded in the oil field.

Novo Engines have stood the test required of them on oil field pumping service where maximum efficiency is required in taking the liquid gold from the ground.

A good piece of equipment deserves a good power unit, so investigate the many heavy-duty features found in Novo industrial engines. Single, two, and four cylinder, water- and air-cooled, 1½ to 22 HP.

SEND THIS COUPON FOR YOUR INFORMATION

Novo Engine Co., 278 Porter St., Lansing, Mich.
Send literature and prices on NOVO ENGINES in the following sizes .....
NAME .....
ADDRESS .....
TOWN .....STATE .....

NOVO POWER

NOVO ENGINE COMPANY
LANSING, MICHIGAN

with Pittsburgh Crucible as sales engineer in the Detroit office.

♦

Extensive additions and alterations at the New York offices and plant of Handy & Harman are nearing completion. Thousands of feet of added floor space have been occupied.

♦

E. H. Anchors, formerly branch manager for Air Reduction Sales Co. at Atlanta, Ga., has been appointed manager of the Oklahoma City district. Mr. Anchors began his career 15 years ago with the Commercial Acetylene Supply Co., and was southern manager of that company when it was acquired by Air Reduction.

♦

A number of appointments are announced by Russell M. Allen, general sales manager, Allegheny Ludlum Steel Corp., Pittsburgh. C. B. Boyne will be manager of stainless steel sales with headquarters in the general office of the corporation at Pittsburgh; J. R. Kumer will be manager of stainless bar and wire sales; Truman B. Brown is the new manager of Ludlite sales with headquarters at Watervliet, N. Y.; C. R. Mitchell Jr. is now assistant district manager of sales for the New York district office; and Deane Murphy will be eastern manager of flat rolled carbon steel sales, with headquarters at New York.

♦

Removal of offices and plant of Harold E. Trent Co., Philadelphia, to larger quarters at Fifty-fifth street and Wyalusing avenue, is announced. Former address was 618-40 North Fifty-fourth street.

♦

United Cinephone Corp. announces the removal of its offices and plant to Torrington, Conn., from 43-37 Thirty-third street, Long Island City, N. Y.

♦

J. S. Billingsley has been appointed manager of the Pittsburgh branch, Crucible Steel Co., succeeding the late M. Stuart Dravo. Offices are in the Oliver building. Mr. Billingsley has been located in the company's Pittsburgh office since 1930.

♦

Charles E. S. Dickerson has been appointed manager of sales of cold finished steel bars, Edgar T. Ward's Sons Co., Pittsburgh. He has been associated with the company since January of this year and prior to that was president and general manager, Miami-Dickerson Steel Co., Dayton, O.

♦

Otto L. Lehecka has been appointed sales representative for Braeburn Alloy Steel Corp., Braeburn, Pa., with headquarters in the Cleveland office. He was formerly with Latrobe Electric Steel Co.

♦

The new research and development plant of the Electrix Corp., 150 Middle street, Pawtucket, R. I., has been occupied. Equipment is most modern, with individual electric drives and direct lighting for each machine.

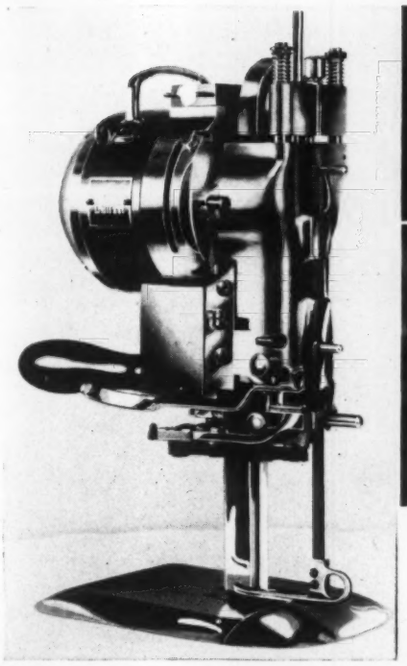
The engineering and patent development department, specializing in patents lending themselves mainly to resinous and rubber compounds, is on the same floor as the mechanical and sample mold development department.

♦

For its line of combustion control equipment the Hays Corp., Michigan City, Ind., has appointed Charles M. Chapman as its Cincinnati representative.

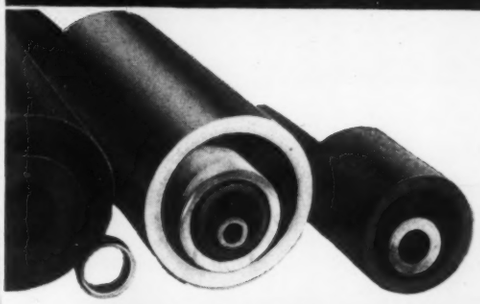
♦

Completion of a new building where electroplating



The self-sharpening Eastman power cutting machine employs Laminated INSUROK Bearings for precision operation. Manufactured by Eastman Machine Co., Buffalo, N. Y.

"MORE PRODUCTION AT LOWER COST"



Users of Eastman self-sharpening cutters enjoy the advantages of greater production at lower cost. Durable, wear-resisting INSUROK plastic bearings are used in the self-sharpening device because of their long life and dependability.

INSUROK

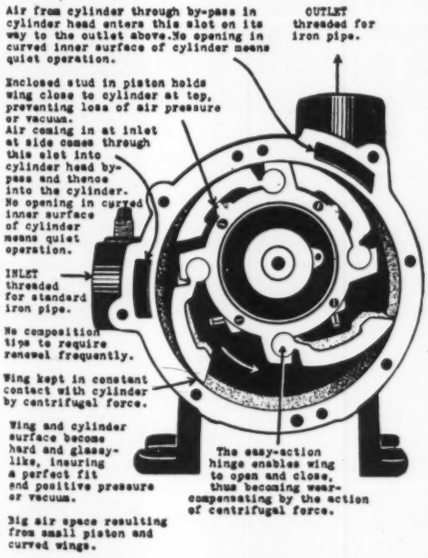
LAMINATED PLASTIC BEARINGS

This installation is but another in the long list of INSUROK Bearing applications. Richardson technicians will be glad to give you complete information and data on the advantages of INSUROK Bearings in your present or contemplated products. No obligation, of course.

The RICHARDSON COMPANY

Melrose Park, (Chicago) Ill. Founded 1858 Lockland, (Cincinnati) Ohio
New Brunswick, N. J. Indianapolis, Ind.
Detroit Office 4-252 G. M. Building, Phone Madison 9386
New York Office 75 West Street, Phone Whitehall 4-4487

Standard Equipment on all sorts of Air Using Devices and used by the world's leaders . . . . .


Air from cylinder through by-pass in cylinder head enters this slot on its way to the outlet above. No opening in curved inner surface of cylinder means quiet operation.
OUTLET threaded for iron pipe.
Enclosed stud in piston holds wing close to cylinder at top, preventing loss of air pressure or vacuum.
Air coming in at inlet at side comes through this slot into cylinder head by-pass and thence into the cylinder. No opening in curved inner surface of cylinder means quiet operation.
INLET threaded for standard iron pipe.
No composition tips to require renewal frequently.
Wing kept in constant contact with cylinder by centrifugal force.
Wing and cylinder surface become hard and glassy-like, insuring a perfect fit and positive pressure or vacuum.
Big air space resulting from small piston and curved wings.
The easy-action hinge enables wing to open and close, thus becoming wear-compensating by the action of centrifugal force.

LEIMAN BROS. PATENTED ROTARY AIR PUMPS
PRESSURE
VACUUM
for use with
GAS AND OIL BURNERS

PAPER FEEDERS
Vacuum Printing Frames
Bottle Fillers
GAS MACHINES
AUTOMATIC DEVICES
MANY SIZES

A Machine That Takes Up Its Own Wear Automatically

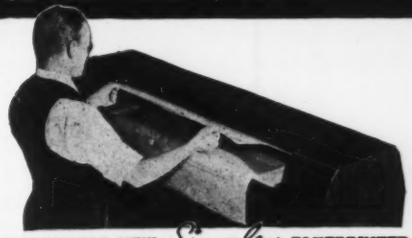
GET THE FREE INFORMATION NO. P3G

LEIMAN BROS. 23-P3G Walker St. NEW YORK CITY

MAKERS OF GOOD MACHINERY FOR 50 YEARS

MAKE YOUR OWN *Blueprints*

FOR LESS THAN 1¢ PER SQUARE FOOT



REMARKABLE NEW *Simplex* BLUEPRINTER CUTS COST, SAVES TIME — NO EXPENSIVE EQUIPMENT. NO EXPERIENCE NECESSARY! · ACT NOW!

Don't give your money to outside firms for blueprints. With a Simplex Mercury Vapor-Tube Portable Blueprinter you can now make blueprints up to 42" wide (any length) in your own offices at a fraction of regular commercial prices. Makes 250 square feet per hour. Can be used for any of the Special Developing Processes. Requires no carbons or globes. Beautiful black crackle "Weaver" finish. Operates silently. Your office girl can easily operate a Simplex.

FREE TRIAL

FREE TRIAL! Don't take our word for the money-saving advantages of a Simplex! For a limited time only we will ship a regulation, complete Simplex Blueprinter on 30 days' free trial. Satisfaction guaranteed or money refunded. Write today for complete facts about this amazing, money-saving offer.

WICKES BROTHERS • SAGINAW, MICH.
512 NORTH WATER STREET

and arc welding equipment used in the production of composite steels will be installed, has been announced by Jessop Steel Co., Washington, Pa., manufacturer of special and alloy steels.

♦

Increased floor space has been added to the Detroit plant of Joseph T. Ryerson & Son Inc., Chicago, to house part of the hot-rolled steel stock and to increase facilities for the company's reinforcing steel service.

♦

Research and testing laboratory, claimed to be the most modern in the country, is being built by Cummins Engine Co., Columbus, Ind.

♦

Dr. H. S. Arthur, McKeesport, Pa., has been made president of Massillon Steel Casting Co., succeeding the late Arthur H. Anthony. Dr. Arthur has been vice president of the company since last August, and director since its organization in 1917. Glenn Wilt, sales manager, has been chosen secretary and a director.

♦

Walter L. Schneider succeeds Matthew A. Carpenter as sales manager in charge of active sales of The Falk Corp. line, with the exception of the foundry division. Mr. Carpenter, secretary of the corporation, will continue in a supervisory capacity over the sales, sales promotion and advertising department.

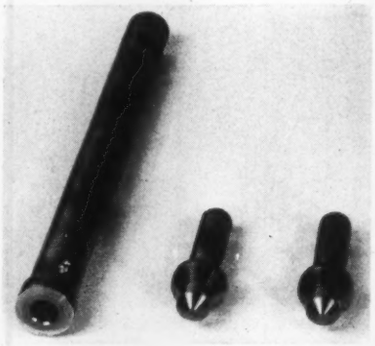
♦

Appointment of Lawrence E. Scrannage as general manager of the forging division at Catasauqua, Pa., in charge of sales and operation, has been announced by The Phoenix Mfg. Co., Joliet, Ill. His experience in the forging field is wide.

Alloy Inserts Improve Performance

RESISTANT to erosive and corrosive action, the slow-up valve illustrated has a small ring of Kennametal inserted in the valve seat and a cone-shaped piece of this material, ground and lapped to the same angle of chamfer, tipped on the valve stem. Both seat and stem are lapped accurately to hold a vacuum.

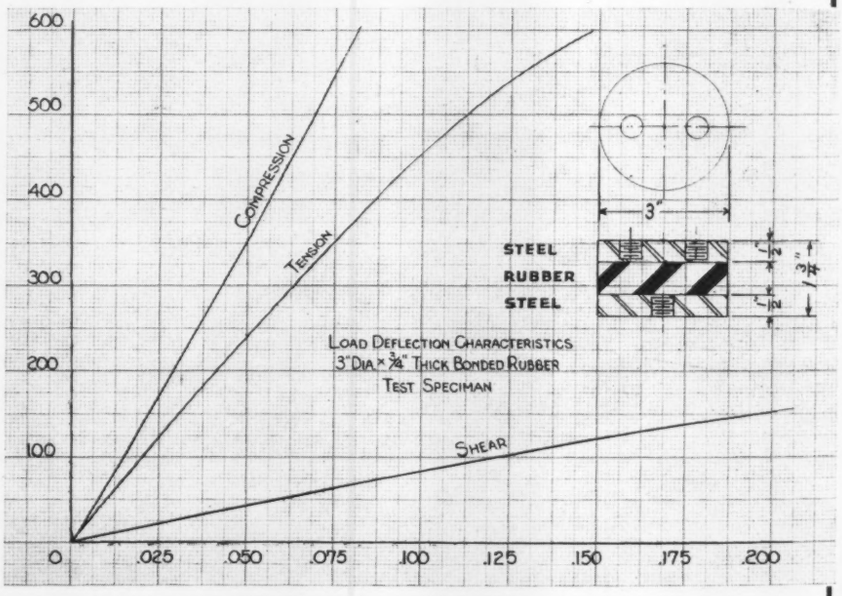
Despite its extreme hardness, about 78 Rockwell C or 91 Rockwell A, this hard carbide material is unusually strong enabling valves on which it is used to resist breakage. Applications include the oil industry where oil containing sand in suspension soon wears out ordinary valves, gas industry where corrosive gases are encountered, chemical industry where high corrosive resistance is required in acid-proof pumps, and in other industries where resistance to abrasion and corrosion is essential.



Why—"IT TAKES RUBBER IN SHEAR TO ABSORB VIBRATION"

FROM the curves it can be seen that for a given load the *deflection in shear* is far greater than in compression or tension. Mountings designed to use rubber in shear can therefore be made to provide softer suspensions with greater ability to isolate vibration than compression or tension units—Lord Bonded Rubber Shear Type Mounts are so designed.

Write for information and for engineering assistance.



LORD MFG. CO.
ERIE, PA. - U.S.A.

BRANCH OFFICES
923 Fairmount Rd.
Burbank, Calif.

BONDED RUBBER JOINTS

LORD
BONDED RUBBER

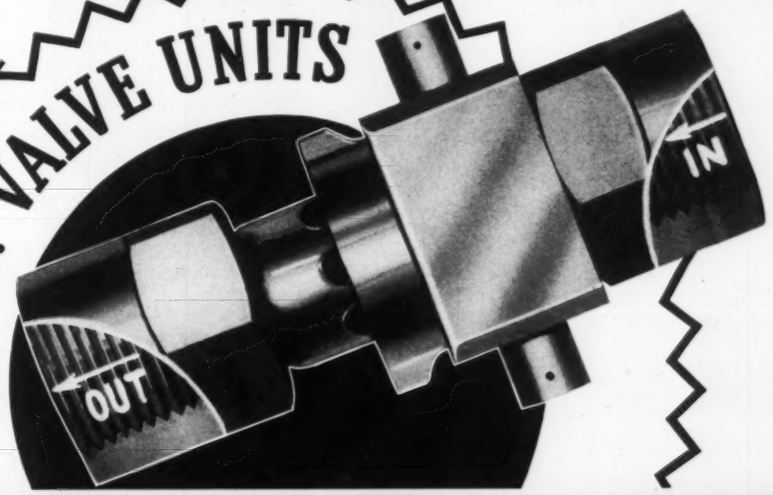
SHEAR TYPE RUBBER MOUNTINGS

280 Madison Ave
New York City
332 S. Michigan Ave.
Chicago, Ill.

It takes rubber in shear to absorb vibration

DESIGN YOUR OWN SPECIAL AIR VALVES...

with Q.A.W. VALVE UNITS



● Because of their compactness, simple easy operation and short sleeve travel, Quick-As-Wink valve units are extremely adaptable—lend themselves readily to any special application. Can be actuated equally well with hand, foot, solenoid, diaphragm, lever, pilot or cam operation. Made in a wide range of sizes to meet every requirement. Send for catalog.

C. B. HUNT & SON
1917 E. Pershing St., Salem, Ohio

QUICK-AS-WINK
CONTROL VALVES

THE HIGHER THE PRESSURE — AIR WATER OIL — THE TIGHTER THE SEAL

MACHINE DESIGN

THE PROFESSIONAL JOURNAL OF CHIEF ENGINEERS AND DESIGNERS

MACHINE DESIGN is devoted exclusively to design problems and development of ideas for engineers and executives in the field of machinery manufacture.

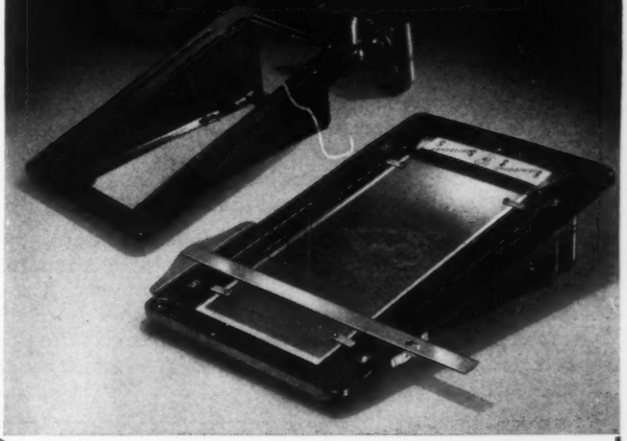
Over 32,000 design engineers and executives in more than 7,800 machinery manufacturing plants read MACHINE DESIGN regularly.

The first publication to devote its editorial content exclusively to discussion of machinery design problems, MACHINE DESIGN remains the only one whose contents, distribution and readership are concerned alone with the design and redesign of machinery.

A Penton Publication

PENTON BLDG. ● CLEVELAND, O.

PLASTIC MOLDED
SPEED-O-SCOPE



The use of molded plastics instead of wood and metal reduced the weight, lowered the production cost and improved the appearance of the Speed-O-Scope.

For large, precision parts molded of plastics, write—

CHICAGO MOLDED PRODUCTS CORP.
1028 North Kolmar Ave. Chicago, Illinois

NEW MACHINES—
And the Companies Behind Them

(For illustrations of other outstanding machinery see Pages 54-55)

Air Conditioning

Compressor-condenser unit, Fairbanks, Morse & Co., Chicago.
Air compressor, Sullivan Machinery Co., Michigan City, Ind.
Dehydrator, Pioneer Engineering & Mfg. Co., Detroit.

Bakery

Mixing machine, American Machine & Foundry Co., Brooklyn.

Confectionery

Two-stage viscolizer, Cherry-Burrell Corp., Chicago.
Filler-crowner for still drinks, Mojonnier Bros. Co., Chicago.
Citrus fruit juice extractor, Mission Dry Corp., Los Angeles.

Dairy

Bottle filler and capper, Cherry-Burrell Corp., Chicago.
Bottle washing machine, The Heil Co., Milwaukee.
60-gallon pasteurizer, Red Wing Co., Addison, Ill.
Bottle cleaner, Geo. J. Meyer Mfg. Co., Milwaukee.

Dry Cleaning

Cleaning system unit, Triplex Corp. of America, Chicago.
Pants shaper, Huebsch Mfg. Co., Milwaukee.
Synthetic cleaning machine, Metal Glass Products Co., Belding, Mich.

Food

Twin volumetric filler, Triangle Package Machinery Co., Chicago.
Processing unit, Abbe Engineering Co., New York.
Transport refrigeration unit, Transport Refrigeration Co., Lansing, Mich.
Turbo-compressor for refrigeration, York Ice Machinery Co., York, Pa.

Industrial

Continuous clean hardening unit, American Gas Furnace Co., Elizabeth, N. J.
Extension spray gun, Air Brush Co. Inc., Newark, N. J.

Maintenance

Full-duty sweeper, Frank G. Hough Co., Libertyville, Ill.
Hydraulically operated scrapers, Gar Wood Industries Inc., Detroit.
Tractor sweeper, Frank G. Hough Co., Libertyville, Ill.
Utility spray tank, Littleford Bros., Cincinnati.
Hydraulic scraper, Bucyrus-Erie Co., South Milwaukee.
Crawler tractor, Allis-Chalmers Mfg. Co., Milwaukee.

Metalworking

Metal rolling machine, Mercury Machinery Co. Inc., Chicago.
Hot and cold rolling mill, Farrel-Birmingham Co. Inc., Ansonia, Conn.
Grinder, Stanley Electric Tool Div., New Britain, Conn.
Air-operated riveting hammer, Ingersoll Rand Co., Phillipsburg, N. J.
Hydraulic straightening press, Lake Erie Engineering Corp., Buffalo, N. Y.
Spiral milling lathe, Hunter Engineering Co., Riverside, Calif.
Nibbling machine, W. J. Savage Co., Knoxville, Tenn.
Combination vertical milling machine, Machinery Manufacturing Co., Los Angeles.
Threading machine, The Oster Mfg. Co., Cleveland.
Plain cylindrical grinder, Fitchburg Grinding Machine Co., Fitchburg, Mass.
Bench lathe, South Bend Lathe Works, South Bend, Ind.

Restaurant

Odor absorber, W. B. Connor Engineering Corp., New York.
Glass washer, Hamilton-Beach Co., Racine, Wis.
Ventilator, J. L. Skuttle Co., Detroit.
Electric fryer, Wells Mfg. Co., San Francisco.
Sterile ray cabinet, Liquid Carbonic Corp., Chicago.

Woodworking

Drilling and routing machine, Ekstrom, Carlson & Co., Rockford, Ill.
Double end sash rail relisher, The Wilkin-Challoner Co., Oshkosh, Wis.
Trucks with hydraulic elevating tables, Lyon Iron Works, Greene, N. Y.

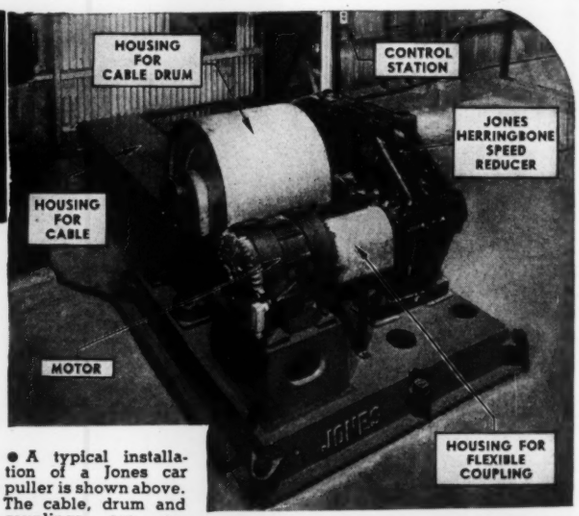
For spotting your cars-
JONES CAR PULLERS

YOU will be surprised how much time can be saved in the spotting and switching of cars by using a Jones car puller. These sturdy, compact units will speed up car handling to the point where they soon pay for themselves in the saving of time and labor.

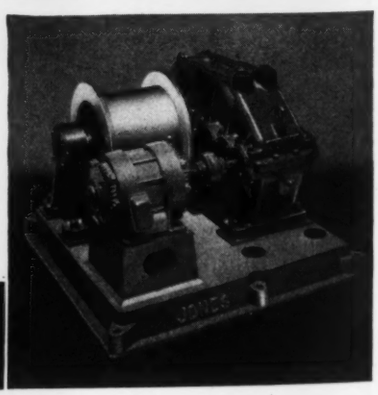
These car pullers are built by Jones as complete units with motor included if desired, or with base to take standard motor, as supplied by the purchaser. The cable drum is driven by a Jones triple reduction Herringbone speed reducer and the control station may be located at a point to give the operator a clear view of the tracks and spotting positions.

Even in plants where comparatively few cars are handled it has been found that a Jones car puller more than pays its way. Prices and complete information will enable you to judge whether such an outfit might pay out in your plant. Write for complete information.

W. A. JONES FOUNDRY & MACHINE CO.
4413 Roosevelt Road, Chicago, Illinois



● A typical installation of a Jones car puller is shown above. The cable, drum and couplings are enclosed by sheet metal housings as an extra precaution in this installation to eliminate all hazard from moving parts.



● A complete Jones car puller unit. These outfits are for use with wire rope and are manufactured in a wide range of capacities to suit the number of cars to be handled in each plant.

Jones
HERRINGBONE—WORM—SPUR—GEAR SPEED REDUCERS
CUT AND MOLDED TOOTH GEARS • V BELT SHEAVES
ANTI-FRICTION PILLOW BLOCKS • PULLEYS
FRICTION CLUTCHES • TRANSMISSION APPLIANCES

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A MODEL to meet practically every mounting requirement, bore and stroke to fit any need and yet overall dimensions are held to a minimum for improving appearance and effecting economies in application. Non-adjustable cushions at both ends reduce maintenance worry and insure long life.

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Company established 30 years. Truly unusual opportunity for right man. Give age, education, present earnings and experience in first letter. All correspondence treated in absolute confidence. Address Box 128, MACHINE DESIGN, Penton Bldg., Cleveland, Ohio.

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